S-125M1 Neva
(SA-3B Goa)
Short Range Surface to Air Missile System
Simulator Documentation



Version 3



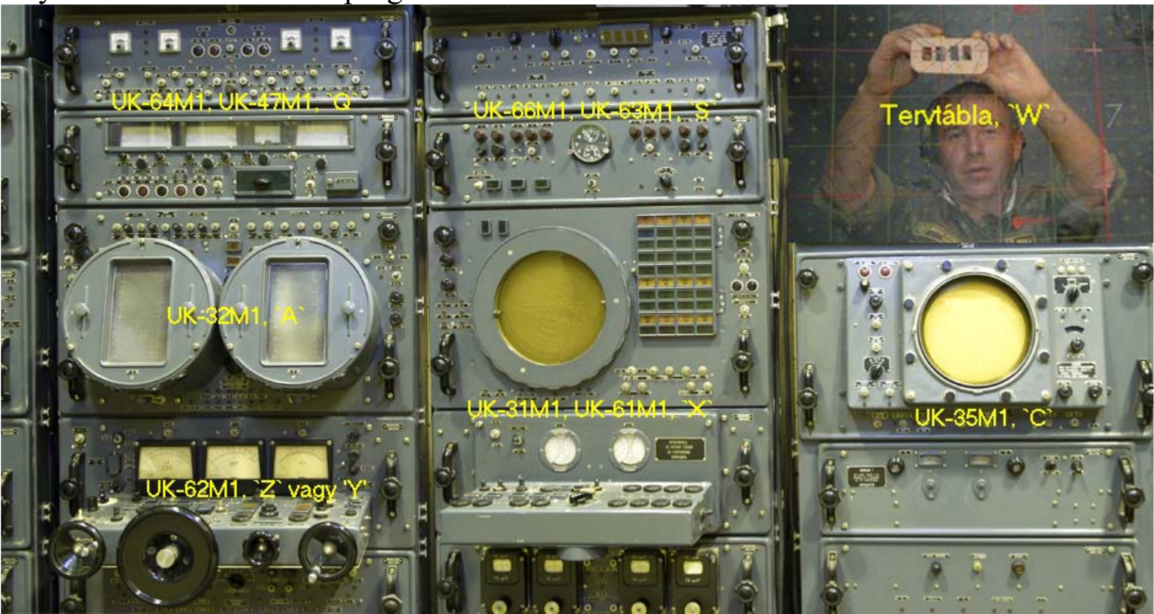


Wreckage of F-117A „VEGA-31" shot down by SA-3B, during Operation Allied Force.

Preface

The “125” SAM system was developed by KB-1 under the leadership of AA Raspeltin. The first versions were fielded from 1961 in the Soviet Union. Hungary operated it between 1978 and 2001. During its service, it was more effective than any contemporary Soviet fighter type.

Keyboard reference of the program:



Requirement to run this program

Computer must be able to display resolution 1280x1024 or above.



Neva system exports

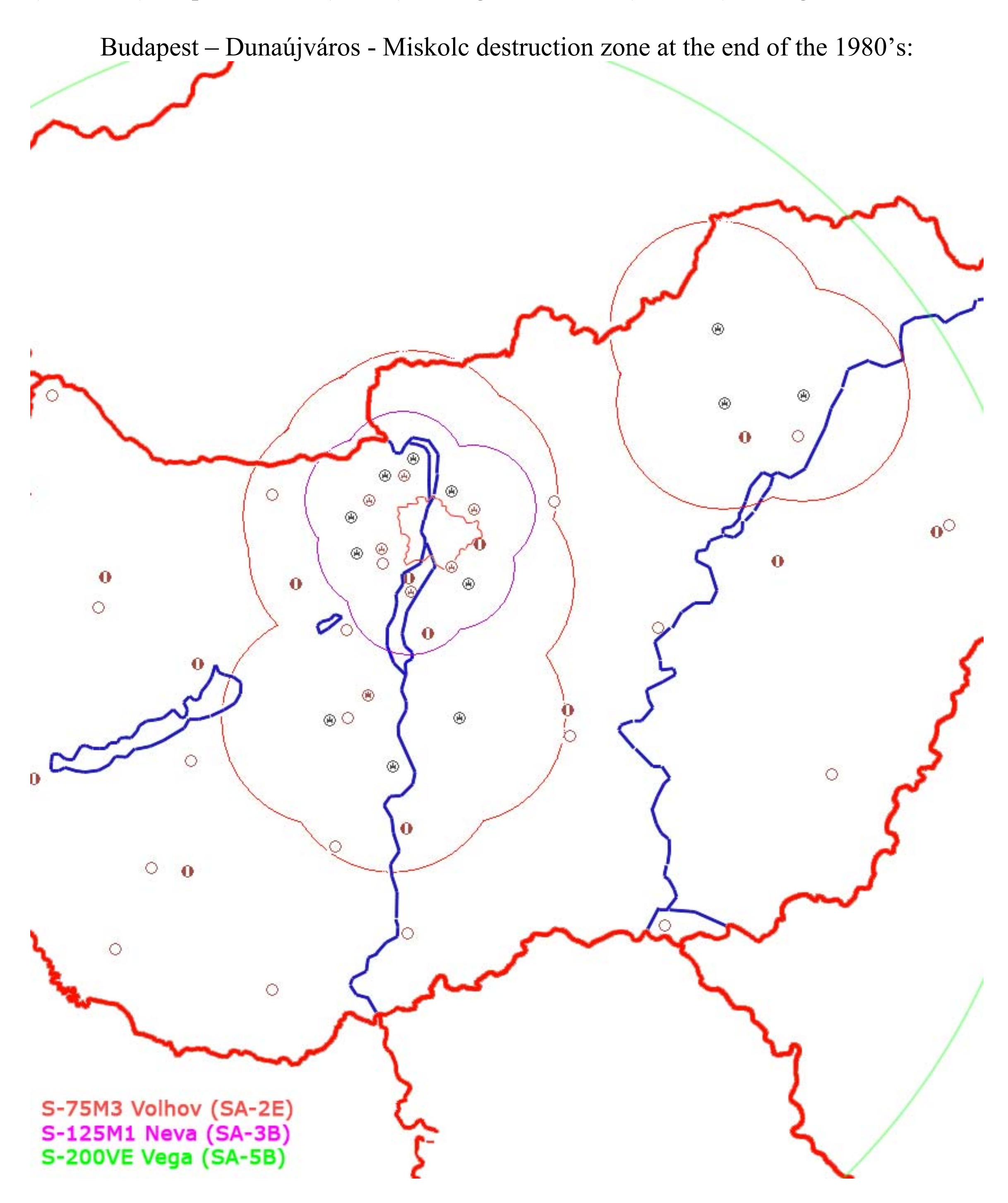
Poland	1969-1, 1970-4, 1974-4, 1975-4, 1978-4, 1979-2, 1983-1, 1985-2, 1986-2
Egypt	1970-40, 1971-8, 1972-3, 1973-16
Czechoslovakia	1971-1, 1972-2, 1975-2, 1977-4, 1979-4, 1980-4, 1981-4
Iraq	1971-4, 1973-2, 1974-3, 1975-9, 1976-3, 1977-3, 1979-2, 1980-5, 1981-3, 1983-4, 1984-8, 1986-6
Syria	1972-8, 1973-4, 1976-3, 1977-3, 1978-6, 1979-3, 1980-6, 1981-6, 1982-3, 1983-4, 1987-1
Vietnam	1972-4, 1973-8, 1979-9, 1980-3, 1981-1, 1982-3, 1984-3, 1986-6, 1988-3
DDR	1972-2, 1973-2, 1979-1, 1983-1, 1985-4
Yugoslavia	1974-4, 1977-4, 1978-1, 1981-3, 1982-1, 1984-2
India	1974-4, 1975-8, 1977-4, 1978-4, 1979-4, 1981-6, 1982-6, 1986-6, 1987-6, 1988-12
Libya	1974-6, 1975-3, 1976-3, 1977-1, 1978-2, 1979-8, 1980-4, 1981-7, 1983-3, 1984-3, 1985-4
Bulgaria	1975-4, 1976-3, 1979-1, 1982-2
Cuba	1975-4, 1976-4, 1983-7, 1984-1, 1987-9, 1988-3
Tanzania	1975-3, 1976-1, 1978-2
Hungary	1976-1, 1978-6, 1980-1
Afghanistan	1977-3, 1989-3
Mali	1977-1, 1983-2
Peru	1977-7, 1978-4
Somalia	1977-3
Ethiopia	1978-3, 1981-4, 1985-4
Mozambique	1978-4, 1985-3
Angola	1979-3, 1980-4, 1983-5, 1985-3, 1986-3, 1987-6
Finland	1979-1, 1980-2
Laos	1980-1, 1984-1
Algeria	1982-4, 1984-4, 1987-4
Yemen	1985-3, 1986-3
Cambodia	1985-1
North Korea	1985-3, 1987-3
Romania	1986-4

These numbers include training systems also.

Engagement zone

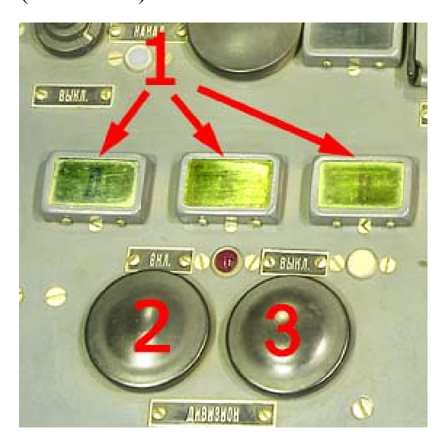
The system has one target and two missile channels, meaning that it can track one target, and guide two missiles onto it. The maximum flight parameters of the target are 700m/s (Mach 2.3) in speed, 25km (14 nm) in range, and 18km (60,000ft) in height.

Budapest – Dunaújváros - Miskolc destruction zone at the end of the 1980's:



Switching simulator on-off

(X - button)



If all three subsystems are ready for action (as indicated by green lamps - 1), then the system can be started by pressing switch (2). To turn off the simulation, push button (3).

Д – RKU-N power distributor cabin
K – UNK fire management cabin (where we sit)
B – UNV SNR-125M1 (Low Blow) fire control radar


Fortified battery post



Methods of target acquisition

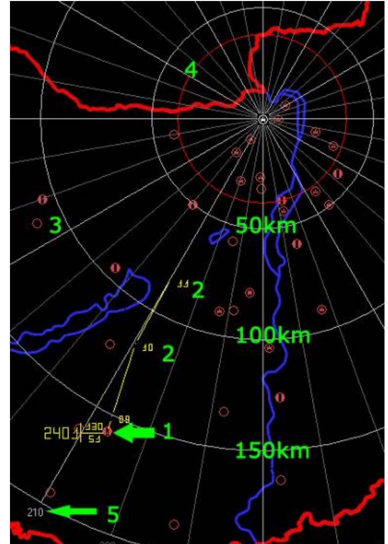
There are three possible methods of target acquisition.

- Plotting table as developed by the British during the World War II.
- Early warning radars (P-15 Flat Face, P-18 Spoon Rest). These made batteries capable of autonomous target detection.
- The integrated air defense system which was fielded in Hungary from 1980.

Plotting Table

(W - button)

The target parameters, detected by the radar battalions (red circles in the table - 3) are written to the glass plotting board.



Target parameters (1) : $2401 \left| \frac{130}{51} \right.$

2401 (Tall numbers) – target number

24 – tactical number of the radar battery, detected the target first

01 – sequential number of the target, detected by the same radar battery

130 (numerator) – Target height in hectometers

(130x100=13,000m or 43,000ft)

51 (denominator) – type of the target (friendly – 1pcs)

(tens digit)

0 – jamming target
1 – friendly target
2 – identified target
3 – border violator
4 – supervisor target
5 – own target
6 – rule violator target
7 – practice target
8 – enemy
9 – target without IFF

(ones digit)

Number of the targets in the formation (1pcs)

The location of the target (2) is updated in every minute, and the timestamp is also written (9, 10, 11, …). In the plotting table, the destruction zone of the battery is marked by a red circle (4). White circles are marking the range from the battery (50-100-150-200km).

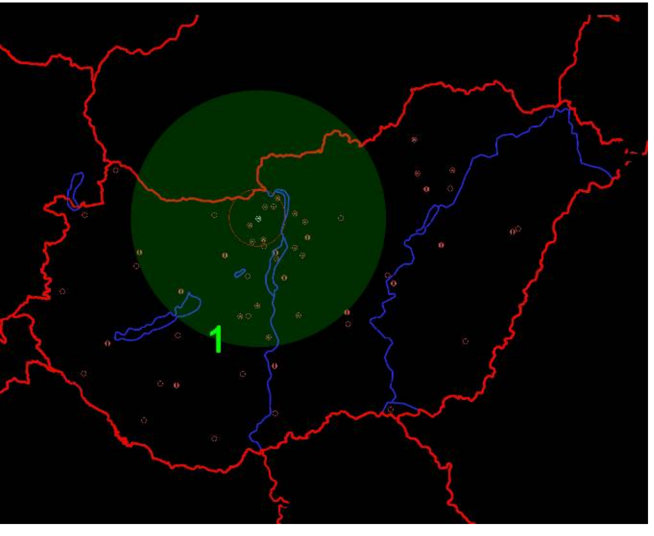
The target direction can be read. (thin line every 10°, strong line every 30°).

Target data read from the plotting table: One own plane, direction 210°, range 80km, height 13km.

P-15 (Flat Face) target acquisition radar

Decimeter wavelength, P-15 target acquisition radar.





The UHF band target acquisition radar detection range is 100km for fighter sized targets (1).

(C - button) P-15 radar indicator in the UNK cabin

1, target at 203°, 92km distance

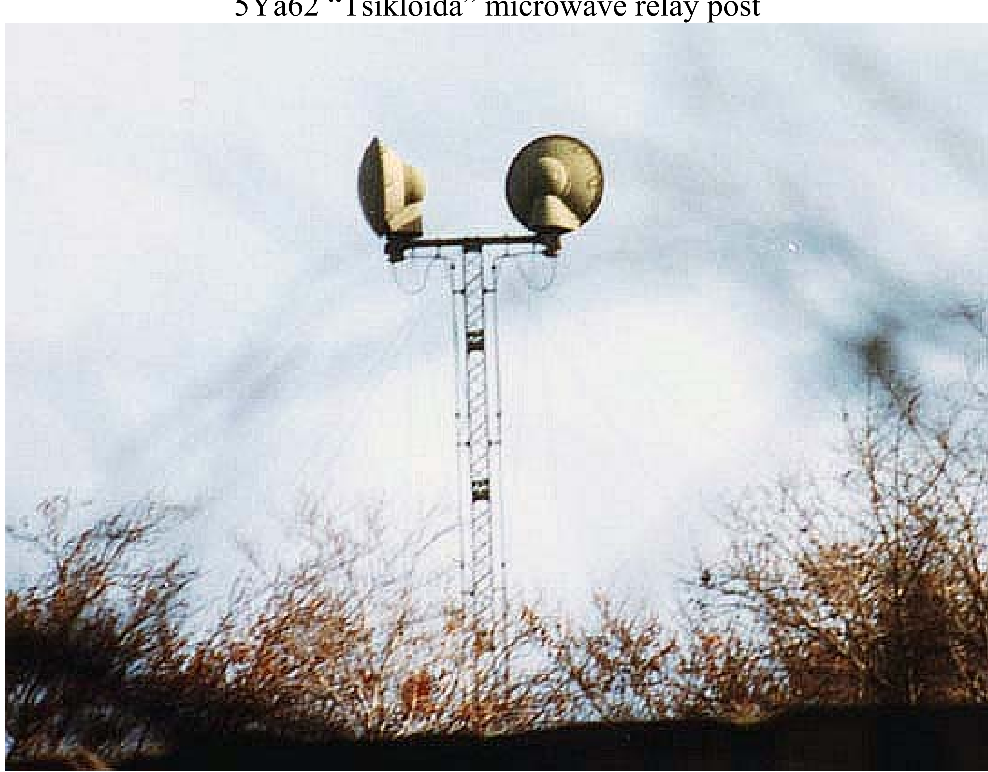
Clicking into the scope area, with left or right mouse button will change its displayed range between 90-180-360km.

Vector-2VE/Senezh-ME, Integrated Air Defense System (IADS)

IADS function is to automate pairing of targets with engagement weapons (fighters or SAMs). It uses information from radar battalions and a data link to transmit the designated target's location to the SAM battalion once every 10 seconds. The SAM battery has two connections to the IADS:

- The main connection is by ground cable
- The backup connection is by the 5Ya62, 5Ya63 "Tsikloida" (microwave relay)The IADS interface to the SAM battery is the 5F24 cabin.

5Ya62 "Tsikloida" microwave relay post



Vector-2VE

Fielded in 1980, at the fortified base "20", near the city of Érd.
Capable of directing …

- 14 SAM batteries (SA-2 Guideline, SA-3 Goa)
- 6 fighter formations (MiG-21 Fishbed, MiG-23 Flogger)

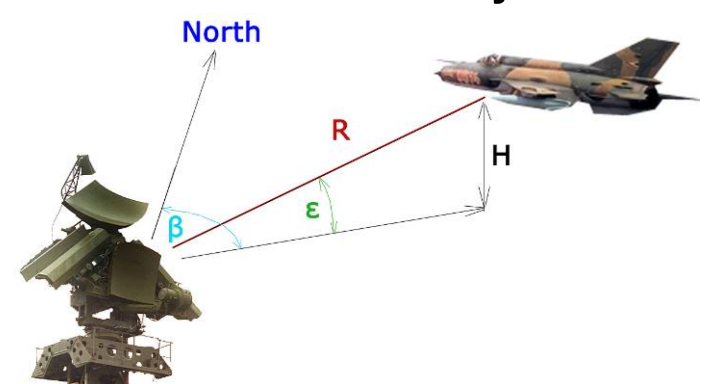
… automatically, against 40 hostile targets simultaneously.

Senezh-ME

Fielded at Szarvaspuszta, during 1988, at the fortified base "50".
Capable of directing…

- 17 SAM batteries (SA-2 Guideline, SA-3 Goa, SA-5 Gammon, SA-10 Grumble), all-together 24 target channels
- MiG-21, MiG-23, MiG-25 fighter formations
- … automatically, against 50 hostile targets simultaneously.

Parametric coordinate system

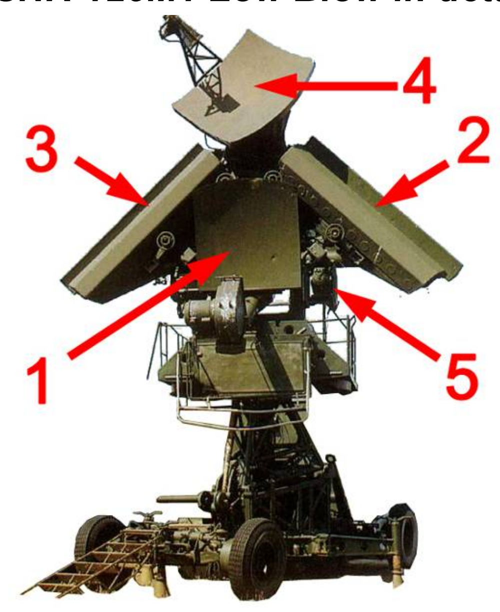


R – target range
H – target height
ε (epsilon) – elevation (antenna up - down)
β (beta) – azimuth (antenna left - right)

SNR-125M1 (Low Blow) fire control radar

Hungary fielded it from 1978.

SNR-125M1 Low Blow in details



1, UV-10, 3cm wavelength, narrow beam transmitter/receiver antenna.
2, UV-11, 3cm wavelength, wide beam receiver antenna. (angle – F1)
3, UV-11, 3cm wavelength, wide beam receiver antenna. (angle – F2)
4, UV-12, decimeter wavelength, missile command transmitter antenna.
5, 9Sh33A camera. (optical channel)

Switching on the SNR-125M1

(X - button)

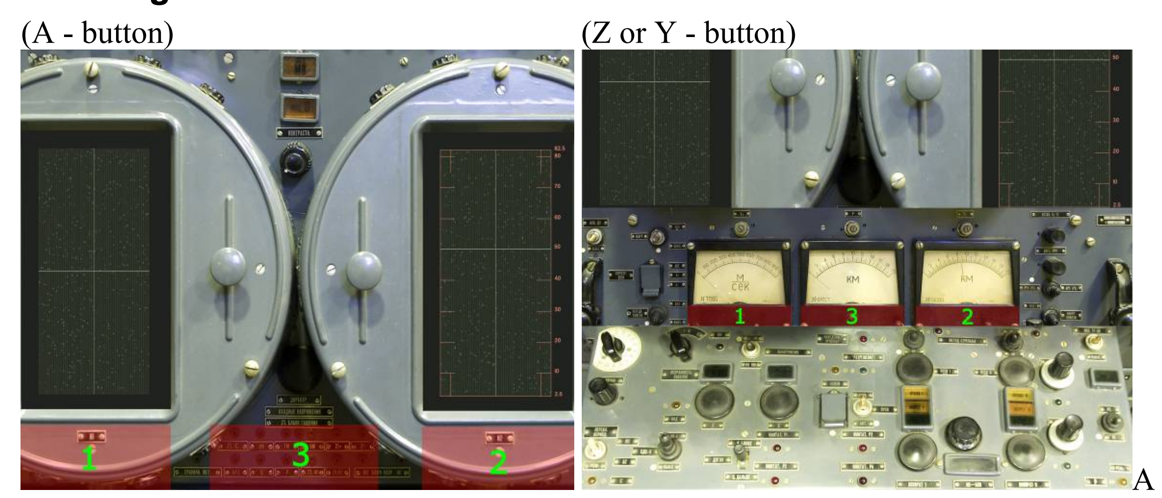


1, Transmitter switch
- on (up)
- off (down), used to track noise jamming targets.

2, Transmitter state indicator lamp
3, Switching between antenna and dummy load. (Antenna - up / dummy – down)

Rotating the SNR-125M1

(A - button) (Z or Y - button)

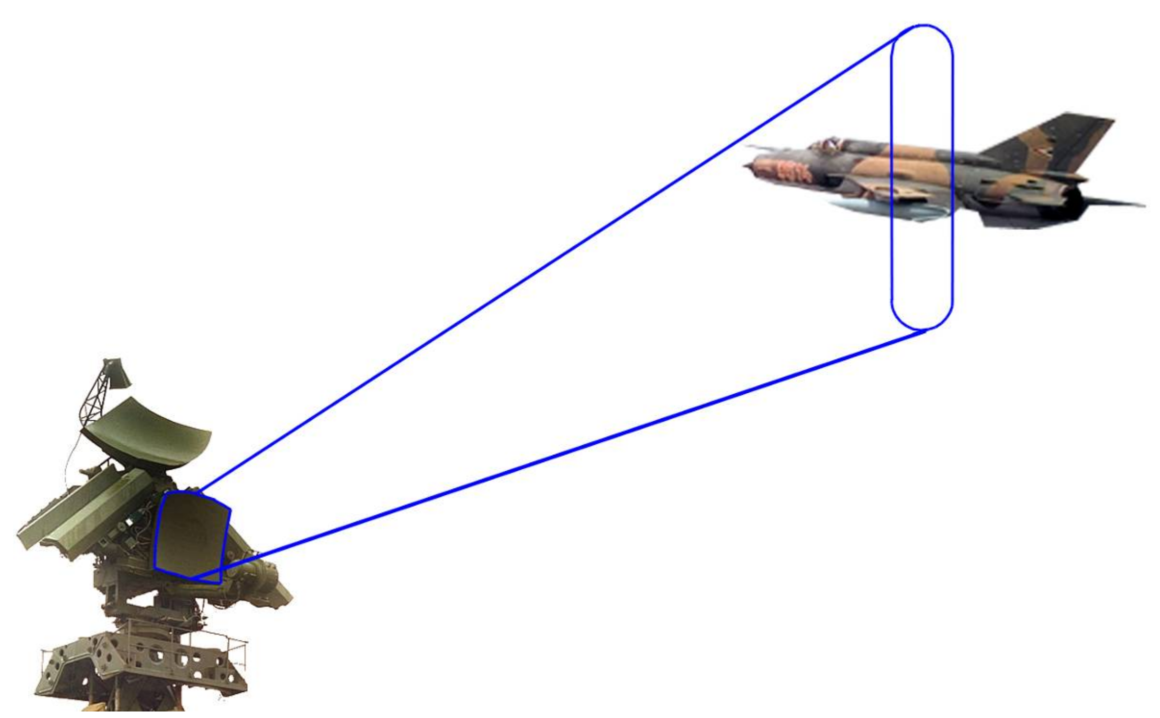


Holding down the left mouse button in the red areas, and moving it to right-left, we can rotate the UNV:

1. ε plane (move the mouse right - up / move the mouse left - down)
2. β plane (move the mouse right – turn left / move the mouse left – turn right)
3. R range boresight (move the mouse right – further / move the mouse left - closer)

SNR-125M1 Target Acquisition

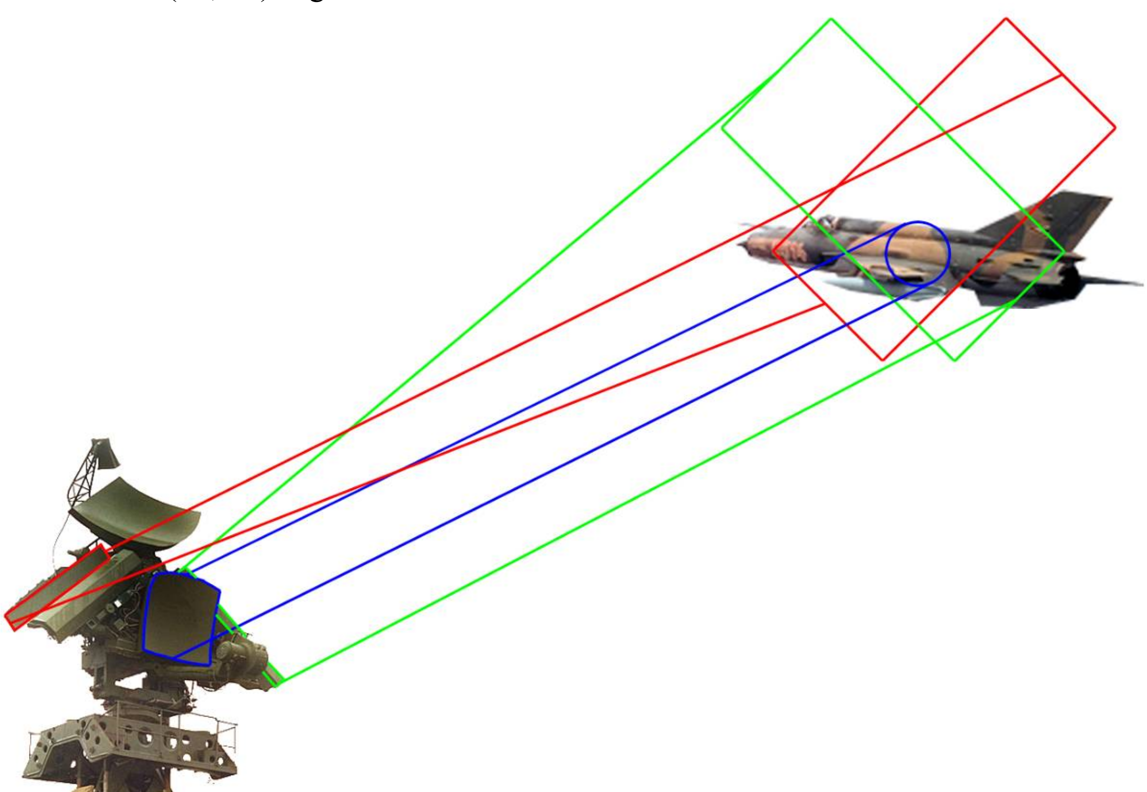
During target acquisition, the pencil beam of the UV-10 antenna is scanning a 10° sector vertically.



The maximum range for target detection range is 80km.

SNR-125M1 Target Tracking

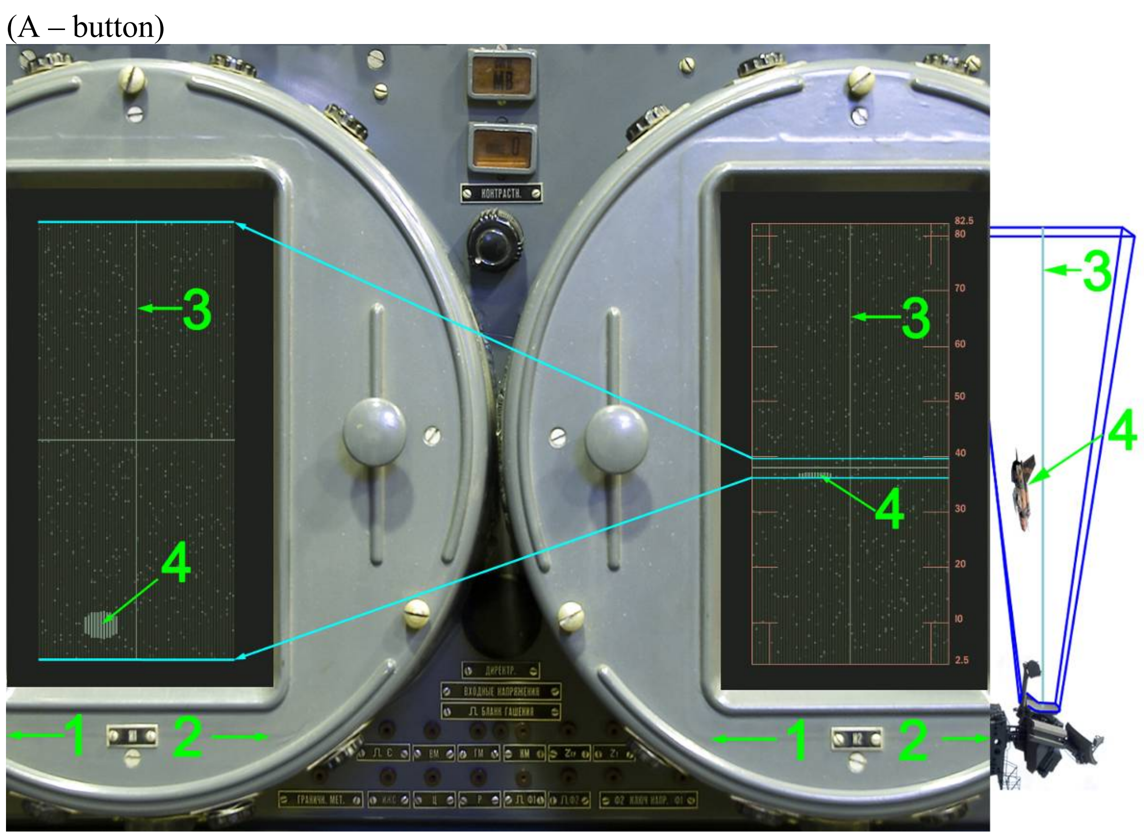
During target tracking, the pencil beam of the UV-10 antenna is illuminating the target, and measuring its range. The two wide beam UV-11 antennas are receiving the target, and missiles (F1, F2) angle.



The maximum range for target tracking is 50km.

Understanding the indicators И1-И2

(A – button)



1, direction down
2, direction up
3, boresight
4, target under the boresight

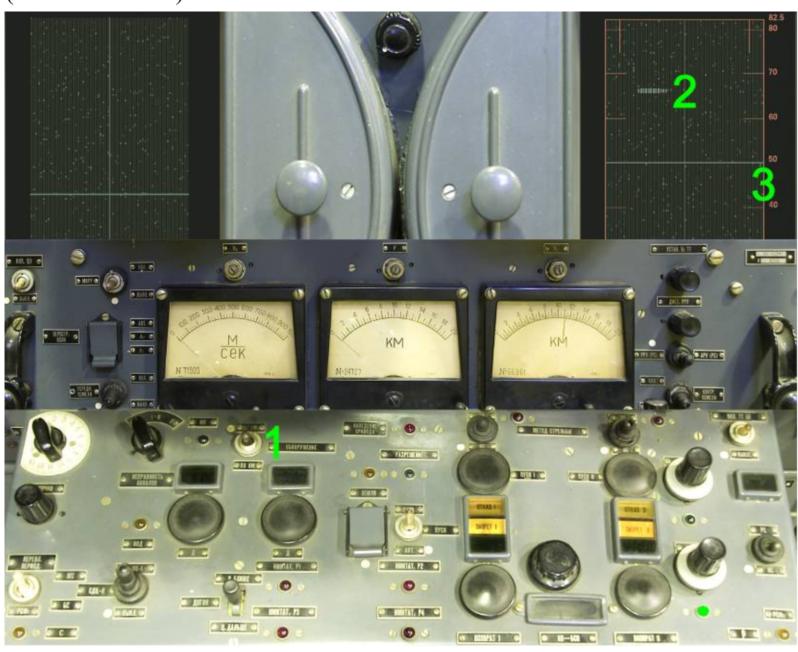
Indicator И1 (left side) is displaying the 3km magnified area of the И2 indicators (right side) range boresight.

Range modes

Two main range modes can be selected, 80km and 40km. In 80km mode, only half of the electromagnetic impulses are sent, as they have to travel double range, compared to the 40km mode.

80km

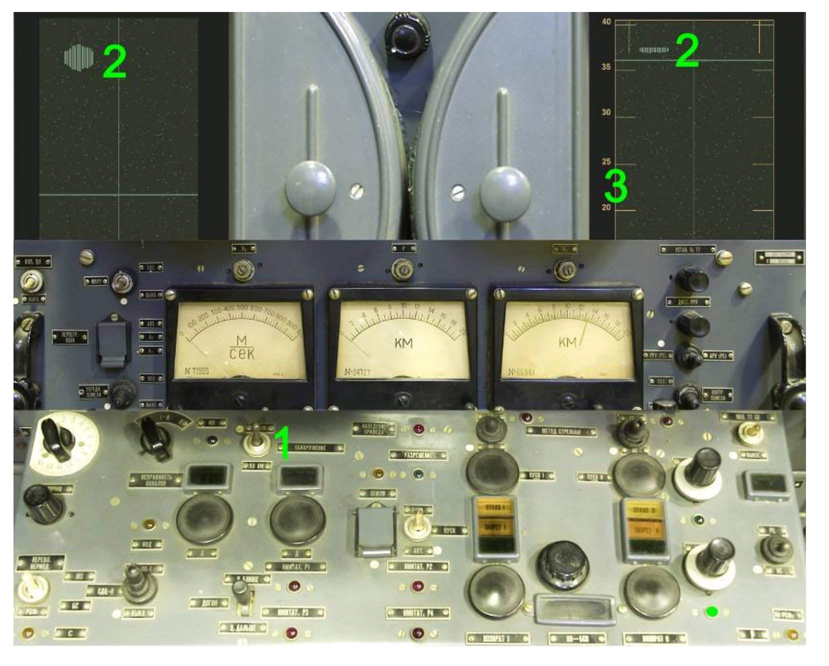
(Z or Y - button)



1, Range selector switch (<u>down for 80km mode</u>)
2, Target at 68km.
3, Range scale is at the right side.

40km

(Z or Y - button)



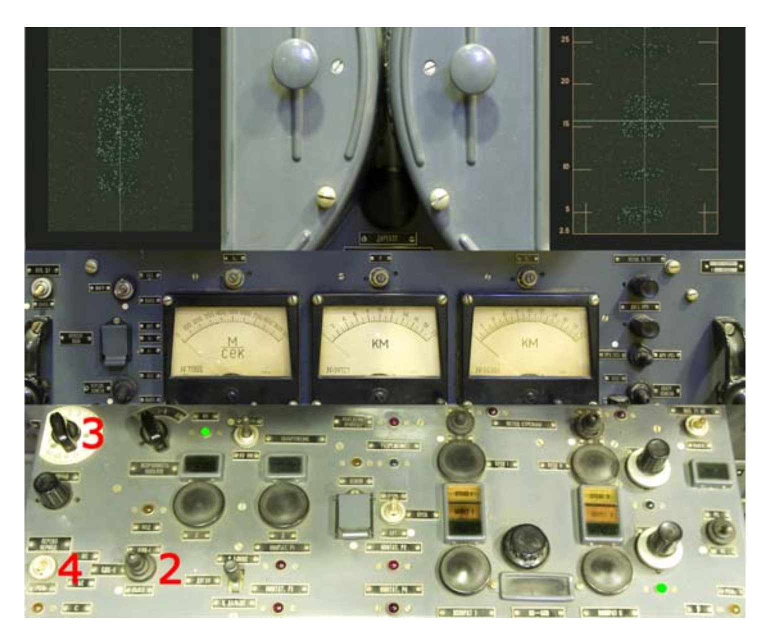
1, Range selector switch (<u>up for 40km mode</u>)
2, Target at 37km.
3, Range scale is now at the left side.

Using the SDC (Moving Target Indicator) to reduce ground clutter

If the target is flying at very low altitude, the ground clutter can make the target acquisition difficult. The SDC using the impulse Doppler mode of the SNR can differentiate between the targets by their radial speed. Important to note, that by the usage of SDC, low radial speed (hovering or parallel flying) targets can completely disappear from the indicator. SDC should be used with 40km range mode only.

Indicators without SDC   Indicators with SDC

1, Low flying target in heavy ground clutter, not visible without SDC.



2, SDC mode selector switch:
OFF, down
SDC2, middle – SDC on
SDC1, up – not used

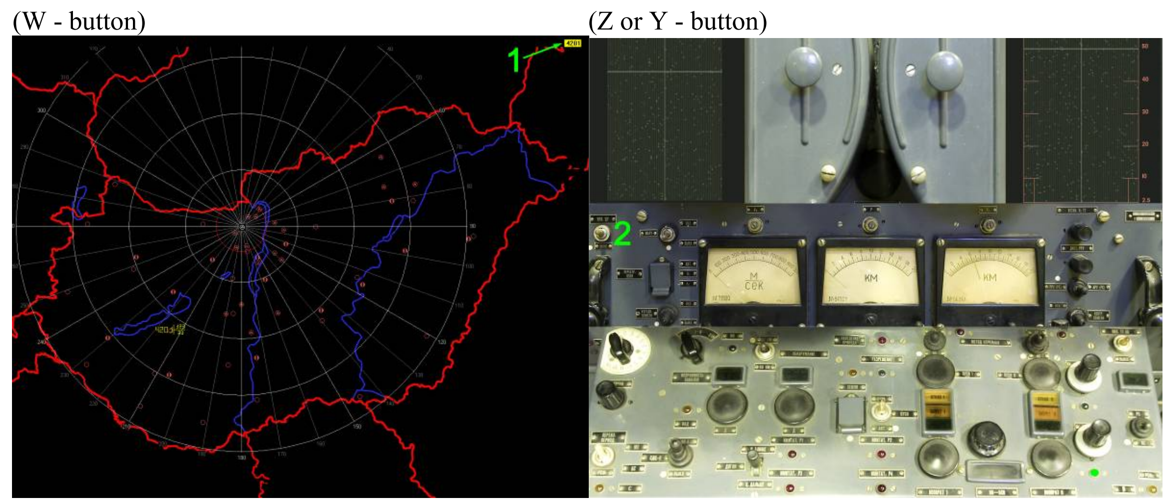
3, The SDC can be fine tuned by holding down the left mouse button over the “wind compensation” knob, and moving it to right-left.

4, target speed selector switch:
BS, down – high speed (target radial speed under 600m/s)
MS, up – low peed (target radial speed under 200m/s)

Target acquisition with Vector-2VE/Senezh-ME, IADS

The primary method of target acquisition is the IADS. It’s transmitting the designated targets actual location, measured by the radar battalions, every 10 seconds.

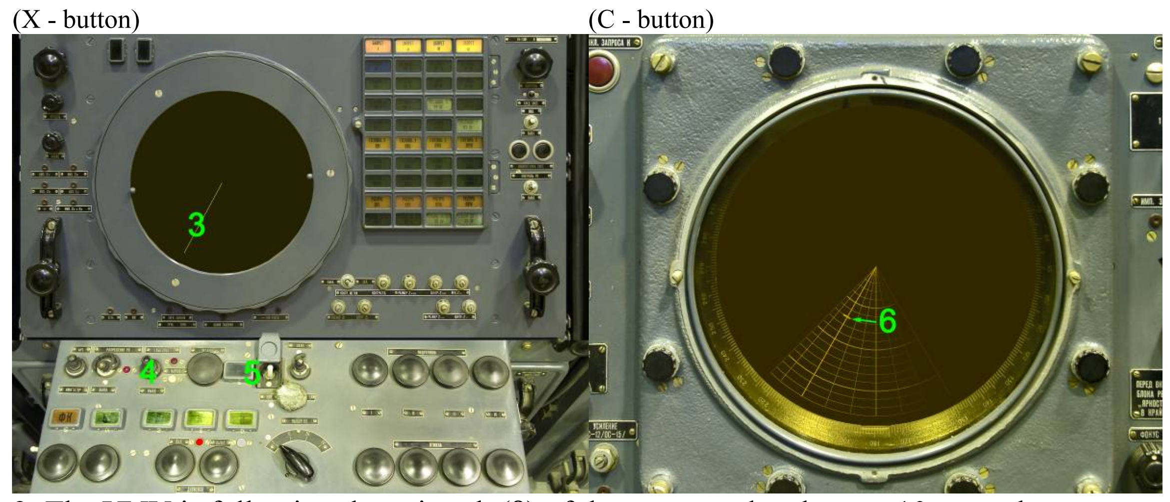
(W - button) (Z or Y - button)



1, Clicking the target number in the plotting table, we can select automatic target acquisition.

2, ВКЛ. ЦУ, (receiving IADS target acquisition) switch - up. In azimuth, elevation, and in range, the SNR-125M1 is continuously following the IADS provided target information, which explains the jump in movement every 10 seconds.

(X - button) (C - button)



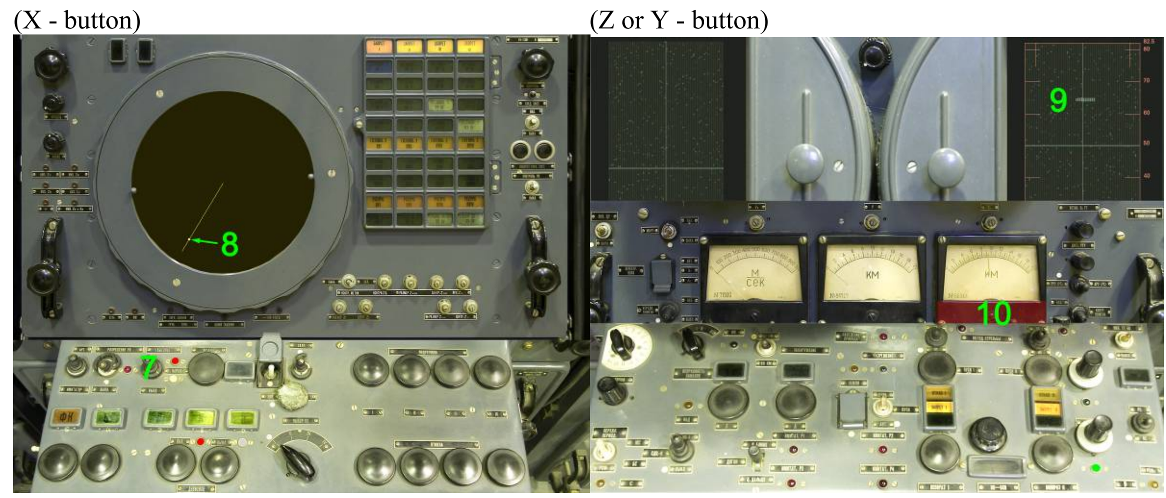
3, The UNV is following the azimuth (β) of the target updated every 10 seconds.

4, Transmitter is off. ВЫСОКОЕ switch down (ВЫКЛ.). Red indicator is extinguished.

5, Antenna is receiving. (АНТ. switch is up.)

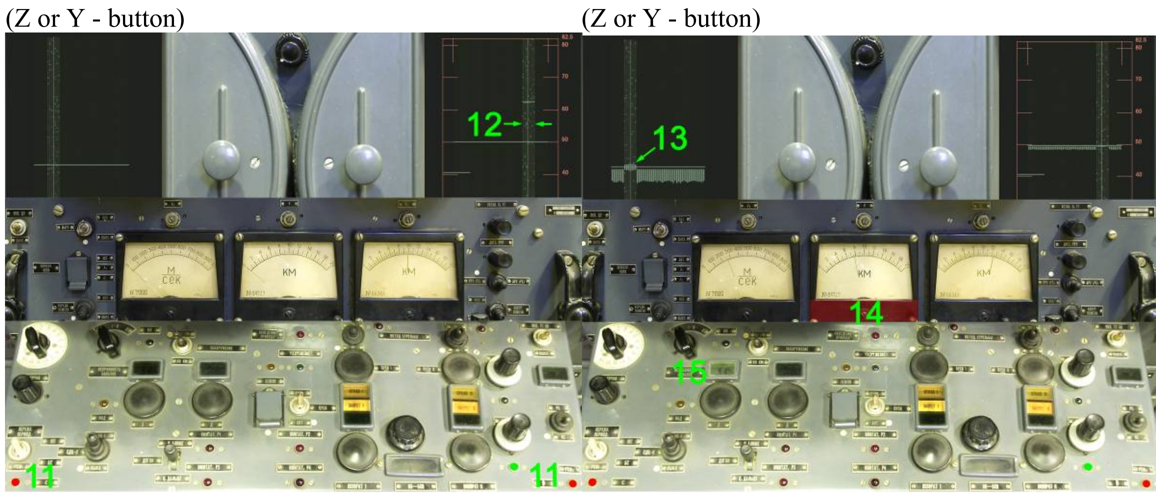
6, Wait, until the target gets inside the acquisition range. (β=210˚, R=70km)

(X - button) (Z or Y - button)



7, Transmitter on. ВЫСОКОЕ switch up. Red indicator is illuminated.
8, Target mark at the УК-31М1 indicator.
9, The SNR-125M1 is following the elevation (ε) of the target sent every 10 seconds. If the boresight touches the target, we can click with the right mouse button in the red area (10), and the SNR-125M1 goes into automatic tracking mode.

(Z or Y - button) (Z or Y - button)

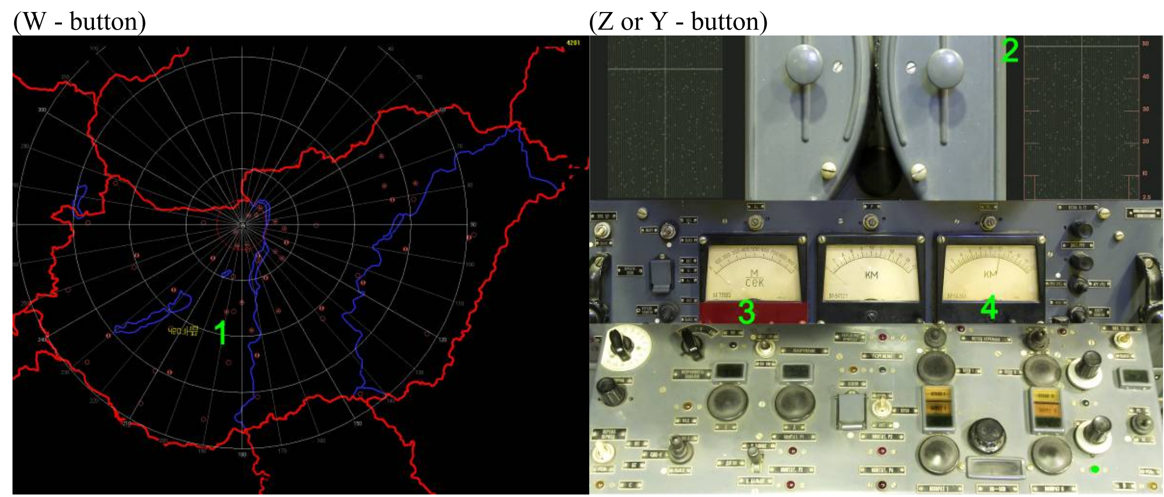


11, The target is in automatic tracking in both angles (F1, F2) and the (РСФ$_1$, РСФ$_2$) lamps are illuminated.
12, The scanning of UV-10 antenna is stopped, the pencil beam is illuminating only the target.
13, If the target touches the range boresight at the И1 (left) indicator, we can click with the right mouse button in the red area (14), and the target gets into automatic tracking in range, the (15) АС-Д (Target is in automatic tracking – in range) lamp is illuminated.

Target acquisition using the P-15 (Flat Face) radar

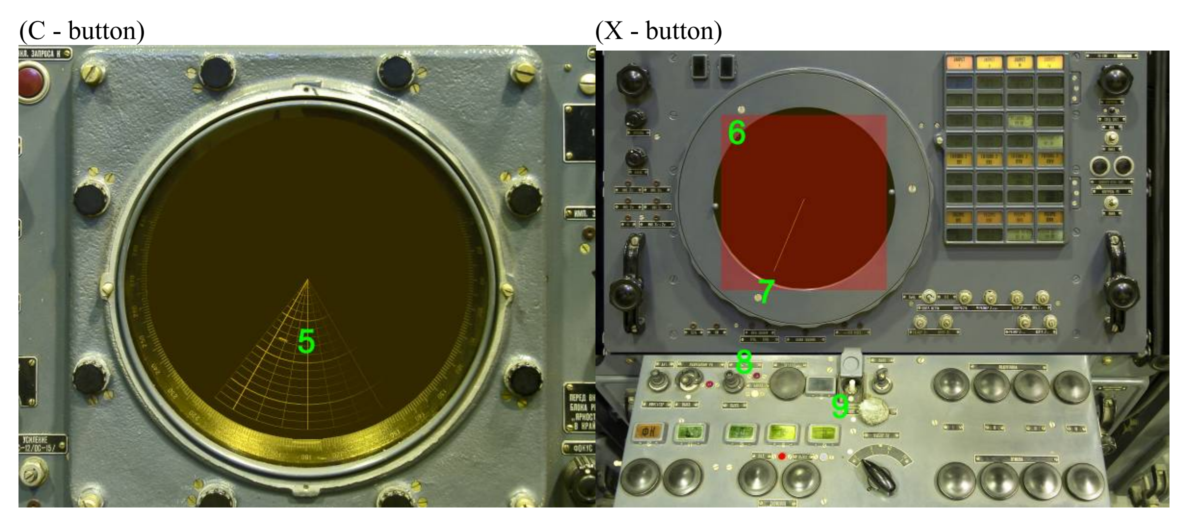
In the absence of IADS, the P-15 is used for target acquisition.

(W - button) (Z or Y - button)



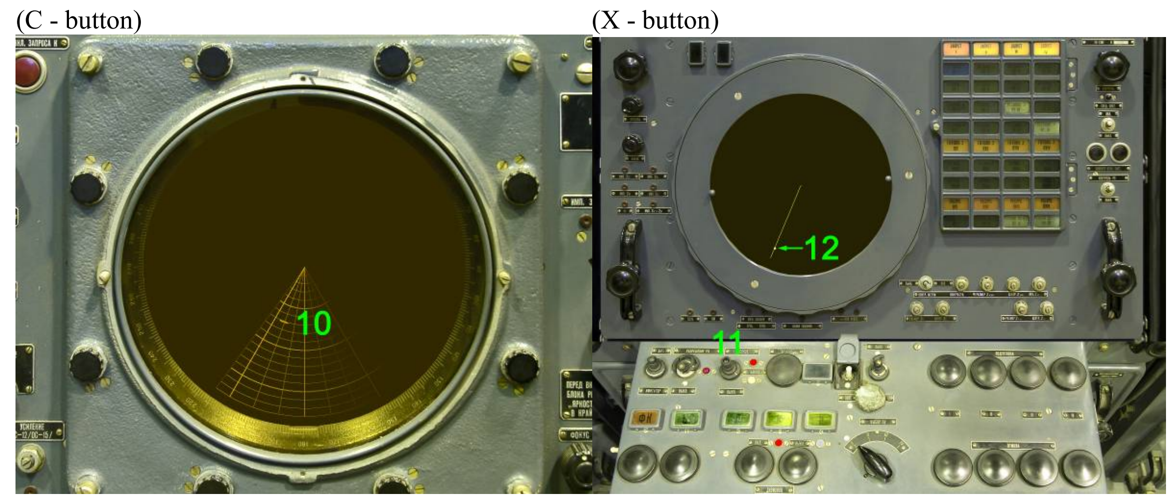
1, Read out the target altitude from the plotting chart. (H=12,300m)
2, The range boresight is moved to the maximum acquisition distance. (50km).
3, In elevation (ε), the target altitude is set (pushing the left mouse button in the red area, and moving the mouse left/right), in the H instrument (4).

(C - button) (X - button)



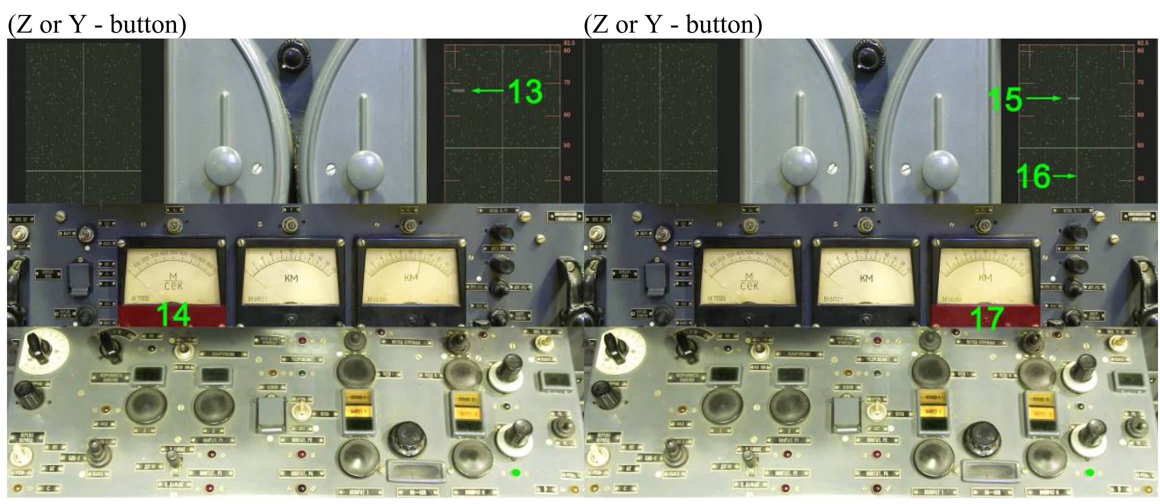
5, Acquire the target with the P-15 radar. (β=203˚, R=79km)
6, Holding down the left mouse button in the red area, and moving it to right-left, we can rotate the SNR-125M1 in azimuth (β). (move the mouse right – turn left / move the mouse left – turn right)
7, The SNR-125M1 is turned to the azimuth (β) of the target.
8, Transmitter is off. ВЫСОКОЕ switch down (ВЫКЛ.). Red indicator is extinguished.
9, Antenna is receiving. (AHT. switch is up.)

(C - button) (X - button)



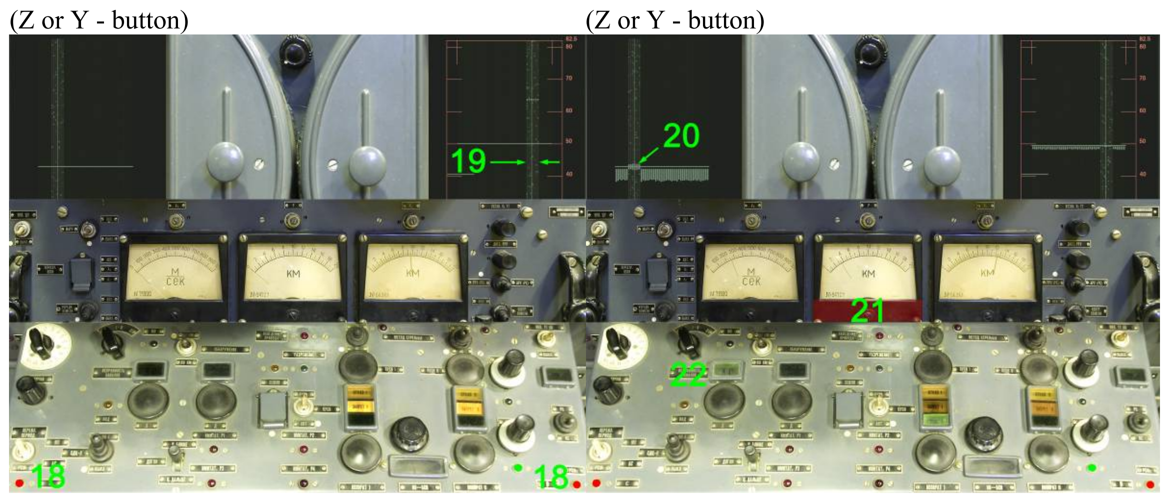
10, Wait, until the target gets inside the acquisition range. (β=203˚, R=71km)
11, Transmitter on. ВЫСОКОЕ switch up. Red indicator is illuminated.
12, Target mark at the УК-31М1 indicator.

(Z or Y - button) (Z or Y - button)



13, Target mark at the И2 (right side) indicator.
14, In elevation (ε), move the target mark, to touch the boresight. (pushing the left mouse button in the red area, and moving the mouse left/right)
15, If the boresight (16) touches the target, we can click with the right mouse button in the red area (17), and the SNR-125M1 gets into automatic tracking mode.

(Z or Y - button) (Z or Y - button)



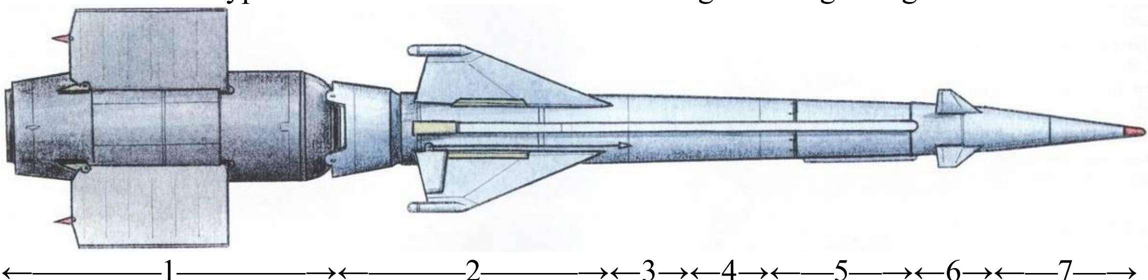
18, The target is in automatic tracking in both angles (F1, F2) and the ($РСФ_1$, $РСФ_2$) lamps are illuminated.

19, The scanning of UV-10 antenna is stopped, the pencil beam is illuminating only the target.

20, If the target touches the range boresight at the И1 (left) indicator, we can click with the right mouse button in the red area (21), and the target goes into automatic tracking in range, the (22) АС-Д (Target is in automatic tracking – in range) lamp is illuminated

V-600P 5V24 (Goa Mod.0) surface to air missile

The first missile type was fielded in 1961. Launch weight: 915kg. Length: 6.09m

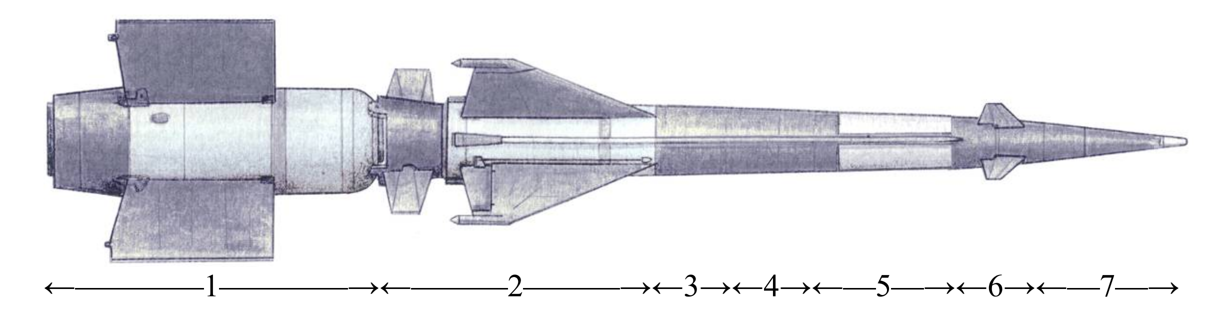


←————1————→←————2————→←–3→←4→←—5—→←6→←—7—→

1. **I. I. Kartukov - PRD-36 5S45 solid fuel booster.**
   Propellant: 14pcs NMF-3K nitrocellulose tube (Ø: 13,5cm)
   Weight of the propellant: 280kg
   Burn time: 4s
2. **Solid fuel sustainer.**
   Propellant: 1pcs NM-4Sh nitrocellulose tube (Ø: 34cm)
   Weight of the propellant: 125kg
   Burn time: 20s
   Range: (min/max): 6/12km
   Max. Altitude: 10,000m
   Max. Speed of the target: 560m/s
3. **APS-600 5A22 autopilot.**
   Flight time: 26s
4. **Air pressure bottle for the steering system. (300bar)**
5. **5B15 warhead.**
   Weight: 52kg
   Explosive weight: 33kg
   Number of fragments: 3,570pcs
   Fragment average weight: 5,4g
6. **Steering fins.**
7. **5E15 radio proximity fuse.**
   Minimum target altitude: 200m

V-601P 5V27 (Goa Mod.1) surface to air missile

Fielded from 1964, the 5V27 has improved sustainer that provides extended flight time, improved warhead and proximity fuse. Launch weight increased to: 952kg
Hungary fielded the Neva system with this type of missile in 1978.



1. **I. I. Kartukov - PRD-36 5S45 solid fuel booster.**
   Propellant: 14pcs NMF-3K nitrocellulose tube (Ø: 13,5cm)
   Weight of the propellant: 280kg
   Burn time: 4s
2. **Solid fuel sustainer.**
   Propellant: 1pcs 301-K nitrocellulose tube (Ø: 34cm)
   Weight of the propellant: 151kg
   Burn time: 22s
   Speed: 780m/s
   Range: (min/max): 3.5/25km
   Max. Altitude: 18,000m
   Max. Speed of the target: 700m/s
3. **APS-600 5A22 autopilot.**
4. **Air pressure bottle for the steering system. (300bar)**
5. **5B18 warhead.**
   Weight: 72kg
   Explosive weight: 51kg
   Number of fragments: 4,500pcs
   Fragment average weight: 4,75g
6. **Steering fins.**
   Max. overload: 6g
7. **5E18 radio proximity fuse.**
   Minimum target altitude: 20m

SM-106 5P73 launcher (PU)

The S-125M1 battery has four launchers, with four missiles per launcher

5V27 missiles on the 5P73 launcher





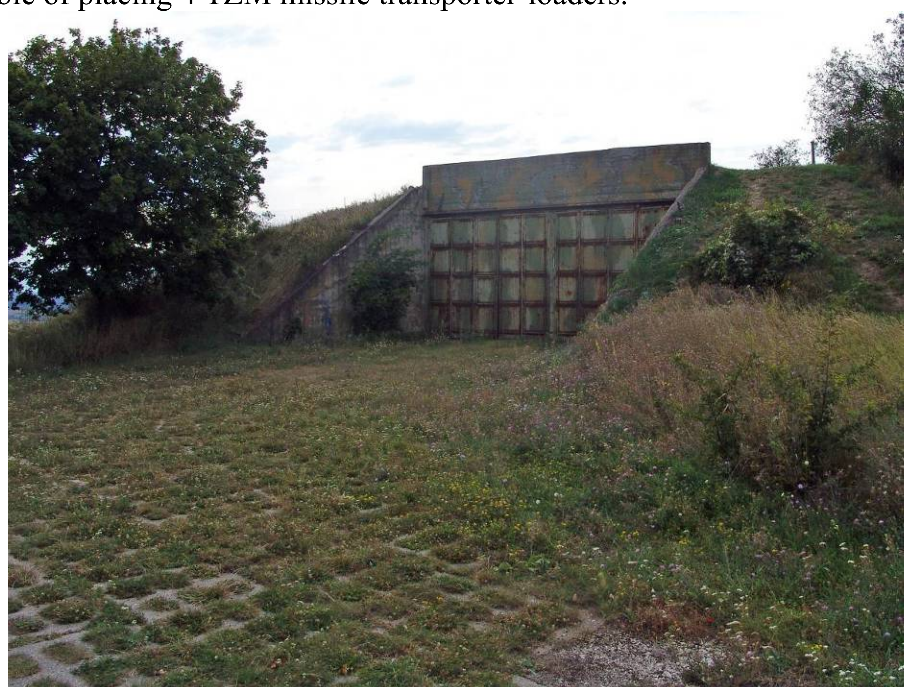
PR-14AM TZM missile transporter-loader

The TZM is a PR-14AM structure built on a ZIL-131 truck. The reload of the missiles is done from the TZM to the 5P73 launcher. The battery has 2 fortified platoon entrenchments with 8 TZM vehicles, each carrying 2 missiles each.



Fortified platoon entrenchment

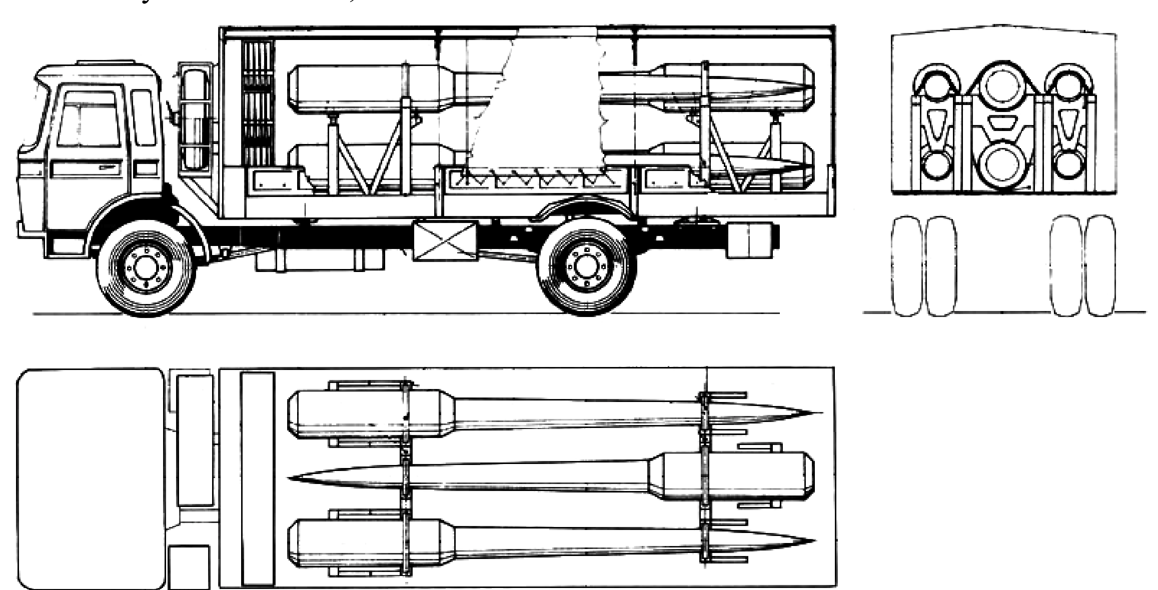
Each battery had 2 fortified platoon entrenchments. Each fortified platoon entrenchments was capable of placing 4 TZM missile transporter-loaders.



Rába missile storage vehicle

After the Middle East experiences, the Hungarian Army tripled the number of the available missiles of a battery, from 16 to 48. To store the 32 extra missiles, a transport vehicle was developed. The Military Institute developed the concept, and the Labor Precision Engineering Works Esztergom Factory created the missile storage vehicle in 1979. The trailer is suitable for transport and long-term storage of 6 missiles.
The 2-axle Rába truck is capable of moving - full load (6 missiles) - on subordinate, and dirt roads.

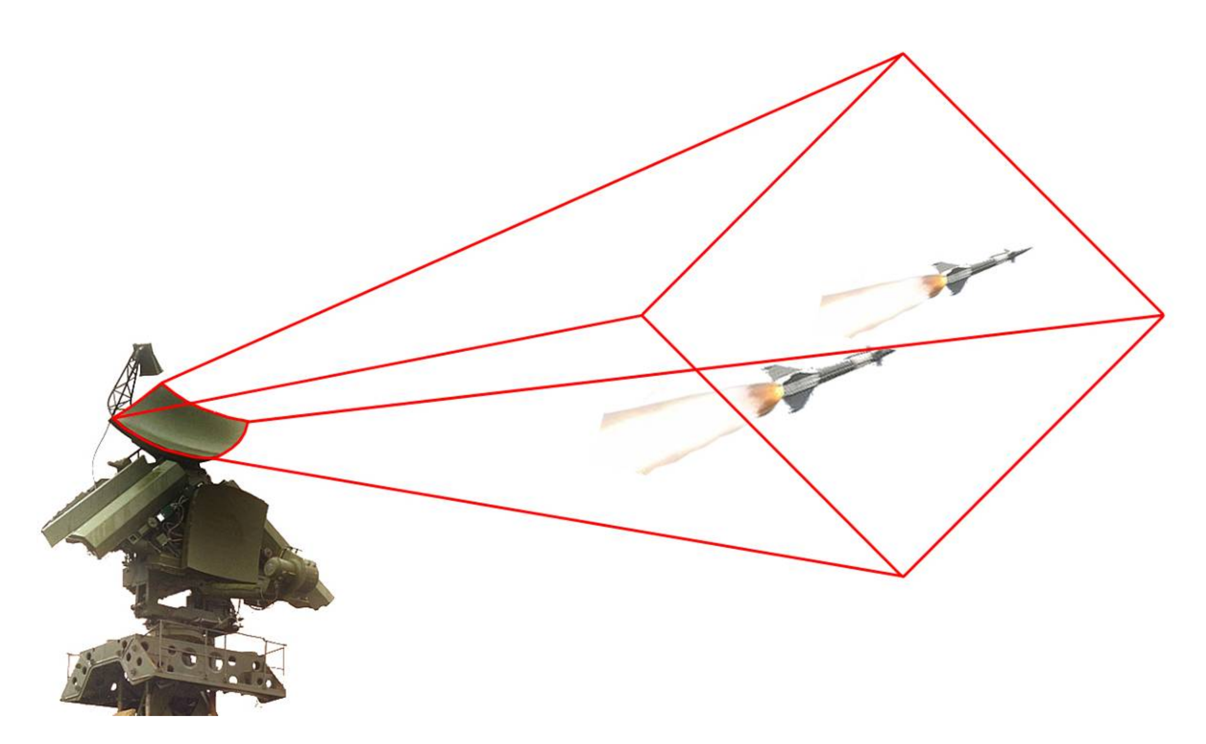
Each battery had 5 vehicles, to store a total of 30 extra missiles.





Selection of the missile guidance method

The missile doesn't "see" the target, it flies by remote control. The UV-12 decimeter wavelength antenna is transmits the guidance signal commands (K1...6).
K1, K2 guidance signal (missile rudder angle command)
K3 radio proximity fuse arming command.
K4 maximum up command, transmitted after missing the target.
K5 command transmitted during the shooting of a ground target.
K6 command transmitted during the shooting of a receding target.



The missile guidance method is selected depending on the target type, and the existence of jamming.
- Lead guidance method, against aerial targets.
- Three point guidance method against jamming aerial targets
- Guidance method against ground targets.

Preparation of the 5V27 V-601P (Goa Mod.1) missiles

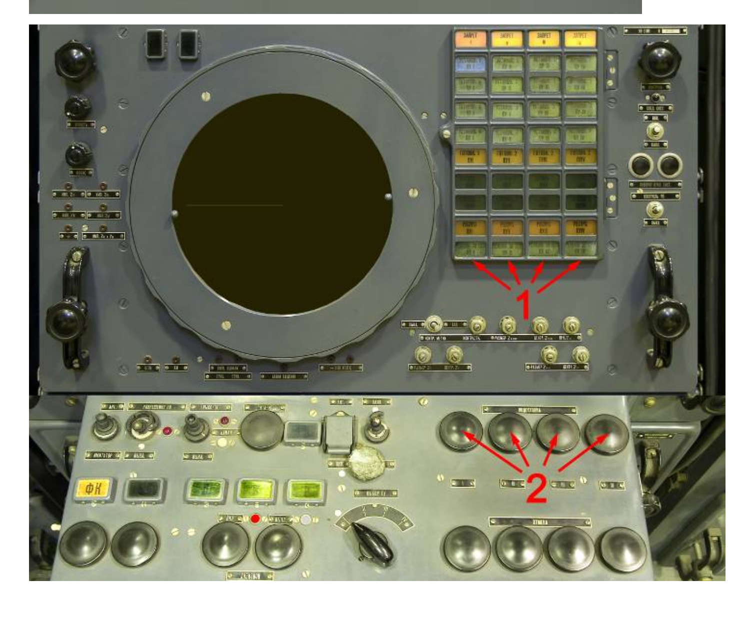
The preparation state of the battery’s 16 missiles can be followed in the UK-31M1 panel.

(X - button)

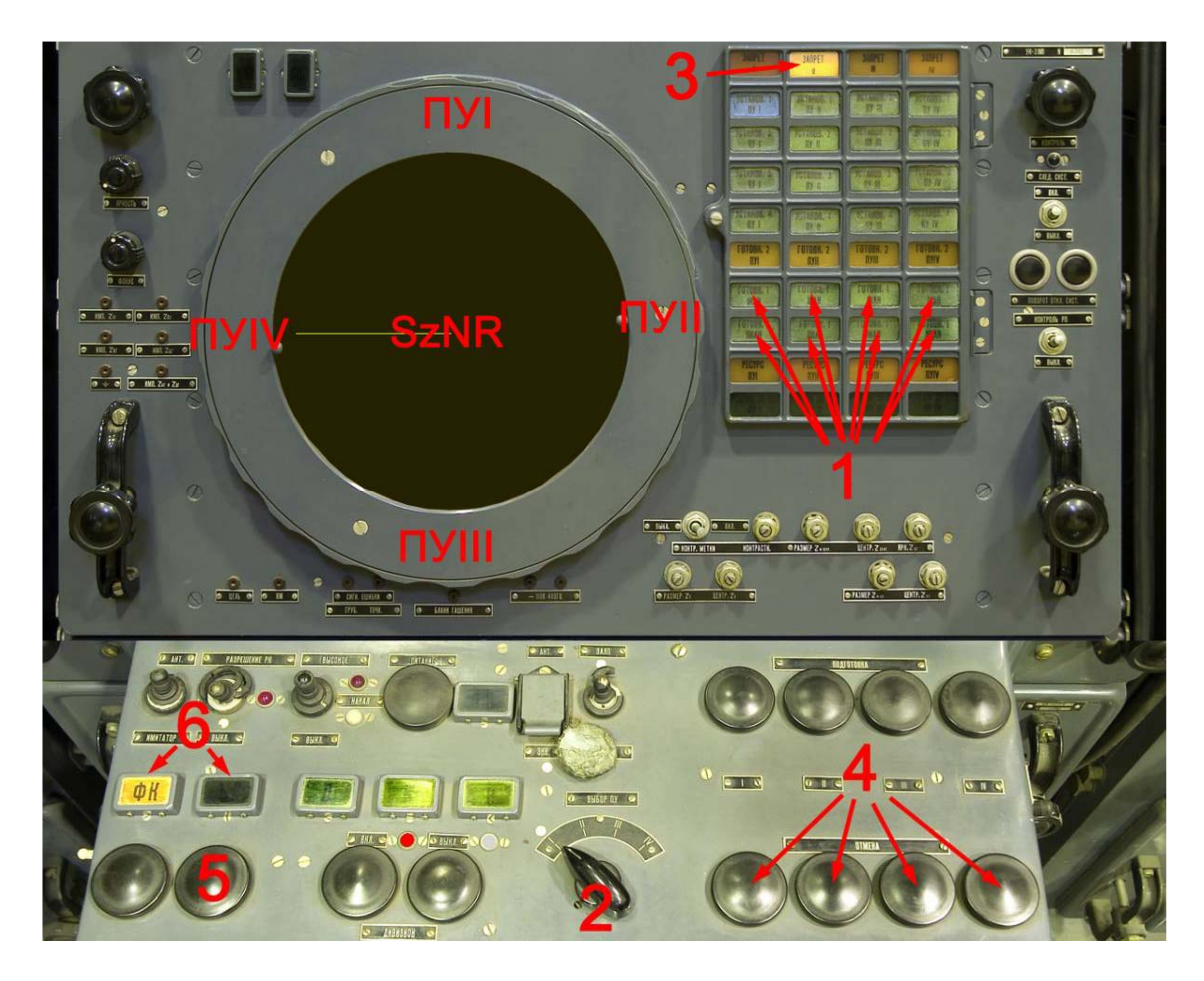


Columns
The four columns display the four launchers in terms of their direction from the SNR-125M1. I North (1), II East (2), III South (3), IV West (4)

Rows
5, **ЗАПРЕТ,** launch prohibited. No ready missiles, or the launcher points to the direction of the SNR-125M1.
6...9, **УСТАНОВ. ПУ** Missile is on the launcher.
10, **ГОТОВН. IКАН** Missile is ready to be launched on channel one.
11, **ГОТОВН. IIКАН** Missile is ready to be launched on channel two.
12, **РЕСУРС ПУ** Third or fourth missile is ready to be launched.
13, **РЕЖИМ 30 СЕК ПУ** Launcher is ready for missile preparation.



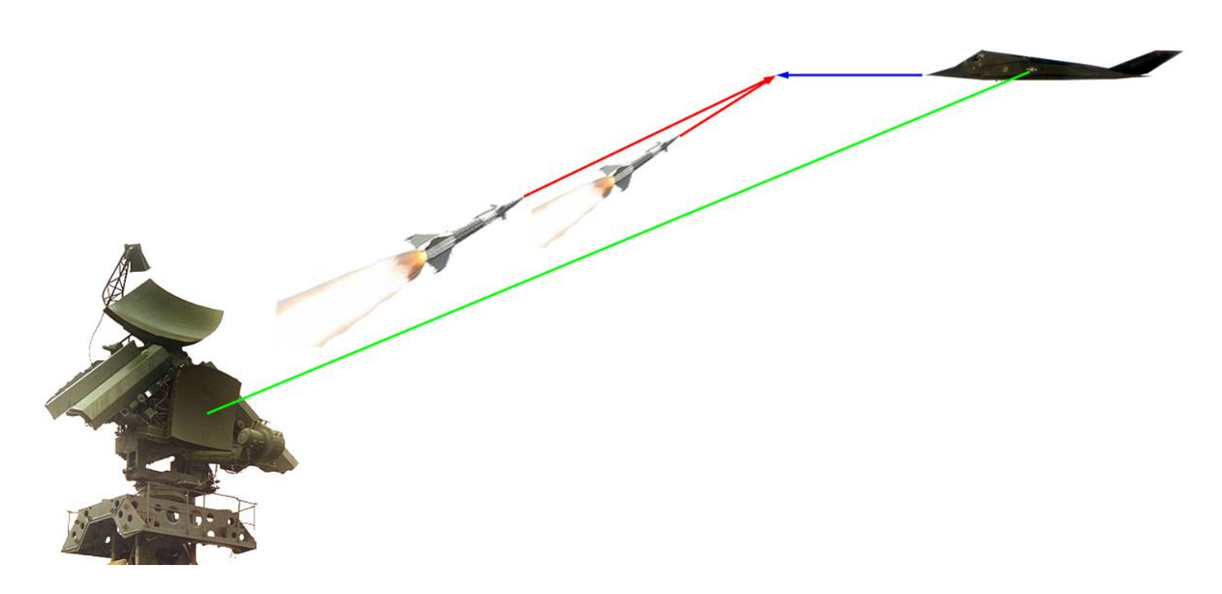
1, If the launcher is ready for missile preparation, the **РЕЖИМ 30 СЕК ПУ** is illuminated.
2, Pressing the **ПОДГОТОВКА** button, the corresponding launcher starts the 30s long missile preparation and the **РЕЖИМ 30 СЕК ПУ** indication is extinguished.



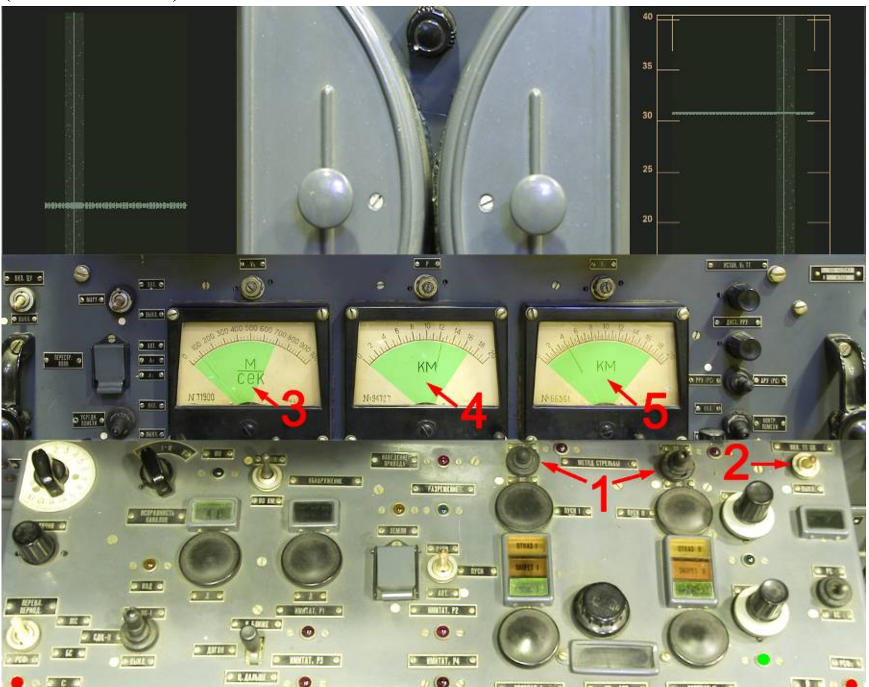
1, After the missile gyroscopes are up to speed, the **ГОТОВН. КАН** (missile channel is ready) light illuminates.
2, The active launcher could be selected by the **ВЫБОР ПУ** switch.
3, Because the SNR-125M1 is looking to the west, it is prohibited to launch from the second launcher **ПУII** (exactly east of the SNR-125M1), as the launched missile would hit the fire control radar (SNR-125M1). The **ЗАПРЕТ II** launch prohibited from the second launcher indicator is illuminated, and prohibits launching from this launcher.
4, If the launcher is empty, we can initiate the reload with the **ОТМЕНА** button. The reload of the four missiles takes approximately three minutes.
5, Pushing the button, the system switches to "live fire" mode.
6, In "live fire" mode, the **ФК** indicator extinguishes and the **BP** illuminates.

Engaging target with “lead” guidance method

Against non-jamming aerial targets, we use the “lead” guidance method. Using this method, the missile is flying to the pre-calculated impact point. The sub-modifications of this guidance method and the radio proximity fuse settings are switched by the system automatically.



(Z or Y - button)



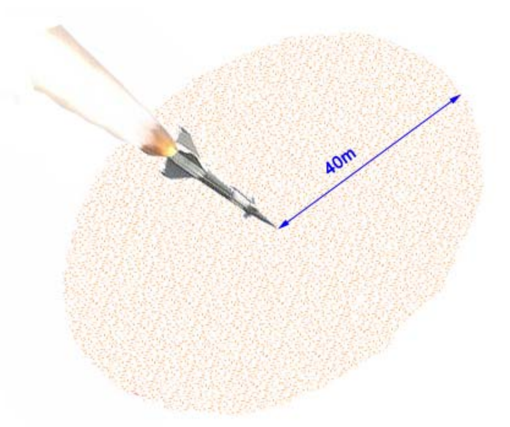
1, Both missile channels guidance method **МЕТОД СТРЕЛЬБЫ** selector is switched to **ПС** down - “lead”.

2, The automatic launcher instrument switch is set to “lead”- down.

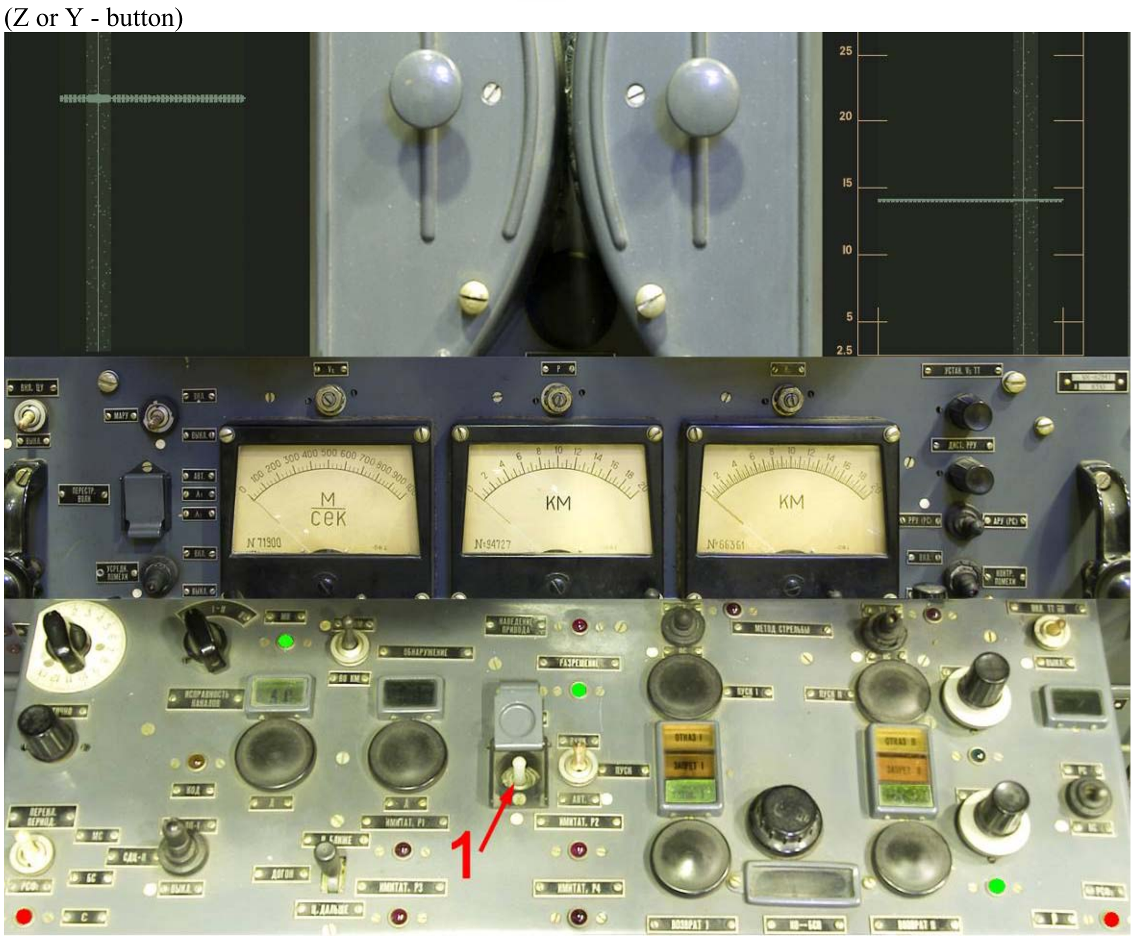
Using “lead” guidance method, the system is capable to engage target of the following parameters: V≤700m/s (3), P≤16,5km (4), H≤18km (5) as shown by the green areas

Engaging ground targets

The S-125M1 (SA-3B) system is capable of shooting ground targets, closer than 17km (9 nm). The V-601P 5V27 (Goa Mod.1) missile's fragments cover an area 80 m (260 feet) wide. The destruction power of the supersonic, (4.75g weight) fragments are comparable to an M-16 rifle's bullet.



(Z or Y - button)



1, Switching the **ЗЕМЛЯ** selector up (right mouse button). The missiles are flying ballistic path, to maximize range.

Determining the missile's launch envelope

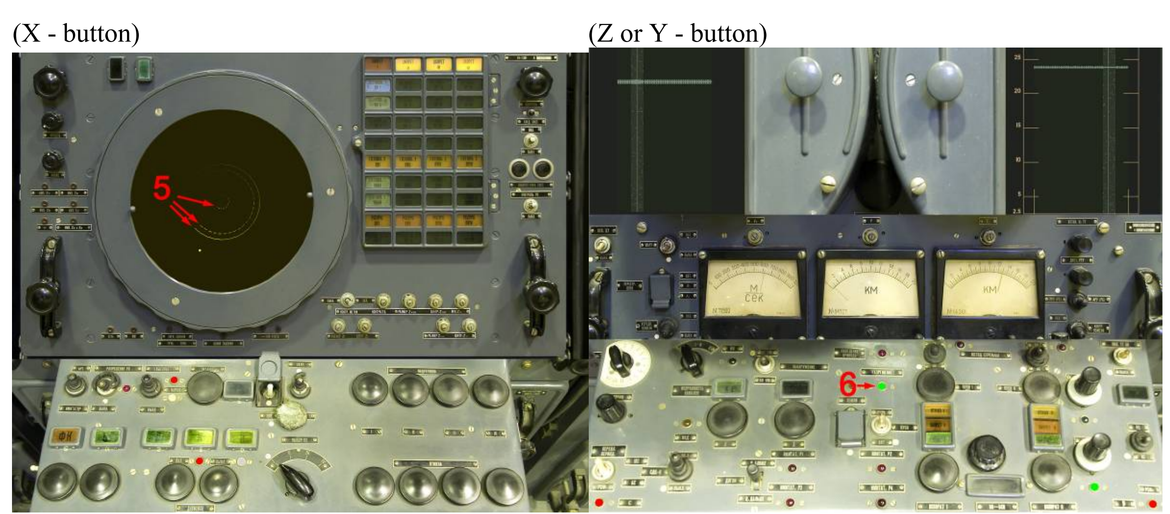
The launch envelope is depending on the target parameters (speed, altitude, course parameter). Using these data, the APP instrument is continuously calculating, and displaying, the launch zone range marks in the UK-31M1 indicator.

(X - button)



1, Target.
2, Missile and Target theoretical impact point. (Broken circle)
3, Missile's maximum range. (Solid circle)
4, Missile's minimum range. (Dotted circle)

(X - button) (Z or Y - button)



5, Target is in the missile's launch envelope. The broken circle is between the solid and dotted circle.
6, **РАЗРЕШЕНИЕ** lamp is illuminated, indicating that the target is in the missile's launch envelope.

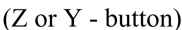
Ну Давай! ПУСК!

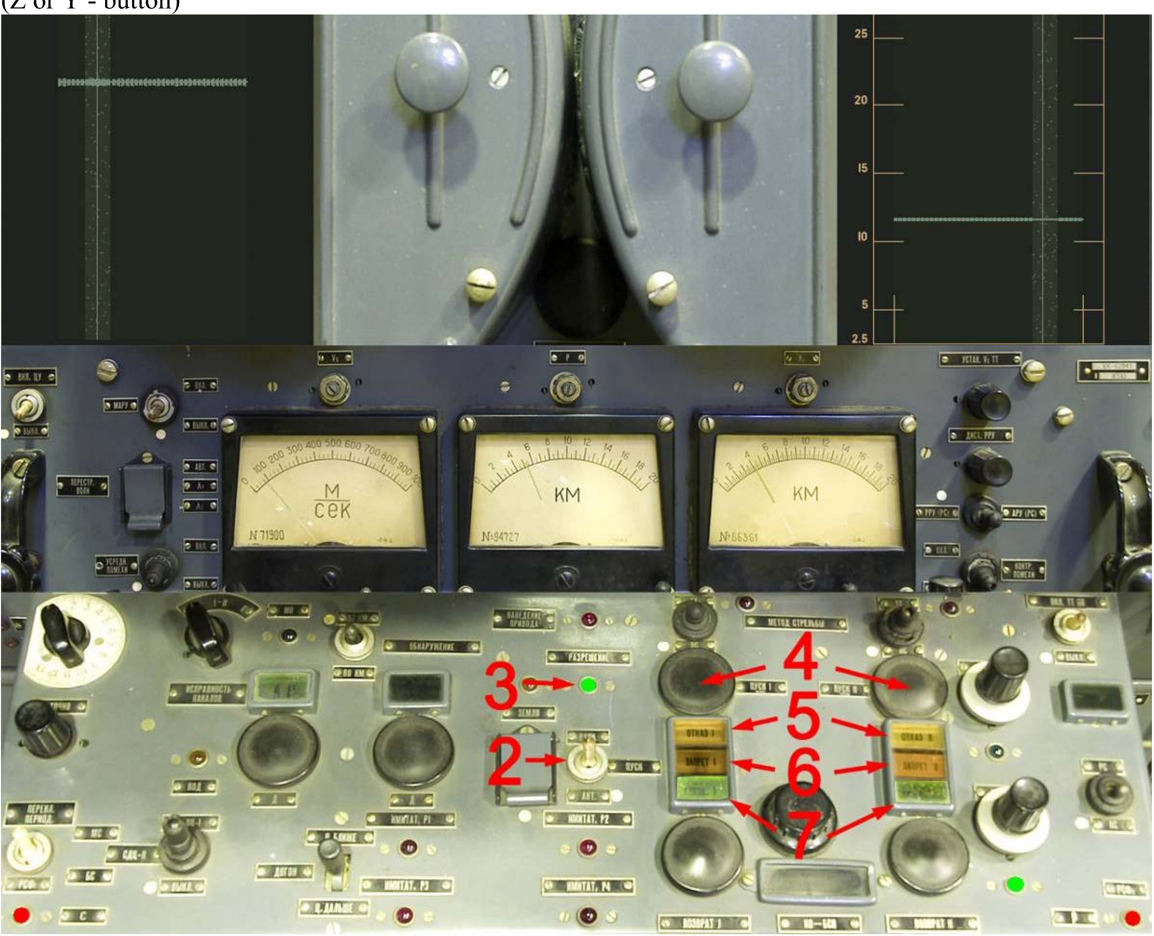
The S-125M1 systems standard method of engagement is the two missile salvo, launched at a 5s interval.

(X - button)



1, **ЗАЛП** (Salvo-up). Using this setting, the system is launching the second missile automatically.
ОДИН (One-down). Using this setting, only one missile is launched.


(Z or Y - button)

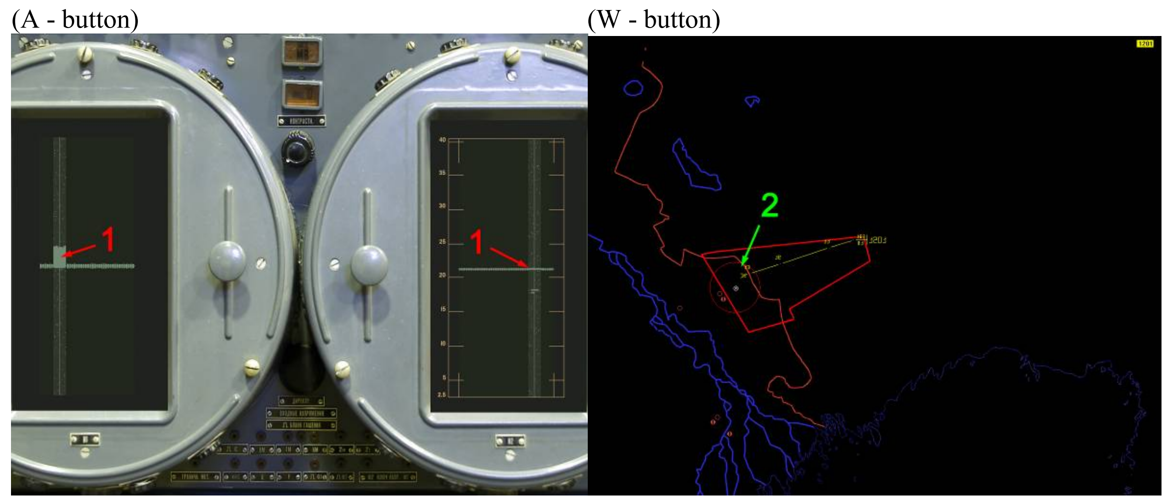


2, **ПУСК** switch, is selecting the method of launch.
РУЧН. (up). Manual launch (4) if there is a ready missile (7), and the launch is not prohibited (5, 6).
АВТ. (down). Automatic launch if the target is in the launch envelope (**РАЗРЕШЕНИЕ** lamp illuminated - 3), there is a ready missile (7), and the launch is not prohibited (5, 6). If the **ЗАЛП** switch (on UK-61M1) is at Salvo mode, then with 5s interval, the second missile is also automatically launched.
4, **ПУСК** button, for launching manually, if there is a ready missile (7), and the launch is not prohibited (5, 6). If the **ЗАЛП** switch (on UK-61M1) is at Salvo mode, we launch with the left **ПУСК I** button. (After 5s interval, the second missile is automatically launched)
5, **ОТКАЗ**, launch prohibited indicator. Illuminated, if the channel is already guiding a missile, or if the 5s interval between launches is not reached yet.
6, **ЗАПРЕТ**, launch prohibited indicator. Illuminated, if there is no ready missile at the selected launcher, or the launcher is pointing at the SNR-125M1 direction. (Case of launch, the missile would hit the fire control radar.)
7, **ГОТОВ.** Missile is ready at the selected launcher.

Observing the result of the shooting

Several factors are needed to be observed, to assess the result of shooting:

(A - button) (W - button)



1, Missile explosion at the target.
2, The place of explosion is marked at the plotting chart by “X”. After successfully shooting at single target, the flight path of the target ends.

(Z or Y - button)



The height and speed of the target rapidly decreases.

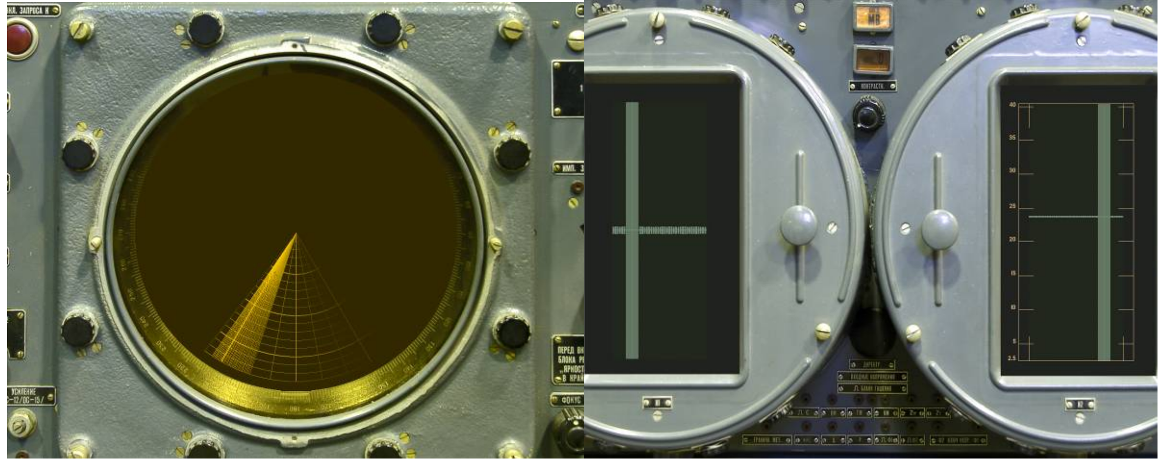
Electronic warfare

Noise jamming



Noise jamming pods, used since the middle of the 60’s, are suppressing the radar echo of the carrier aircraft with strong noise, denying the range information from the fire control radar.

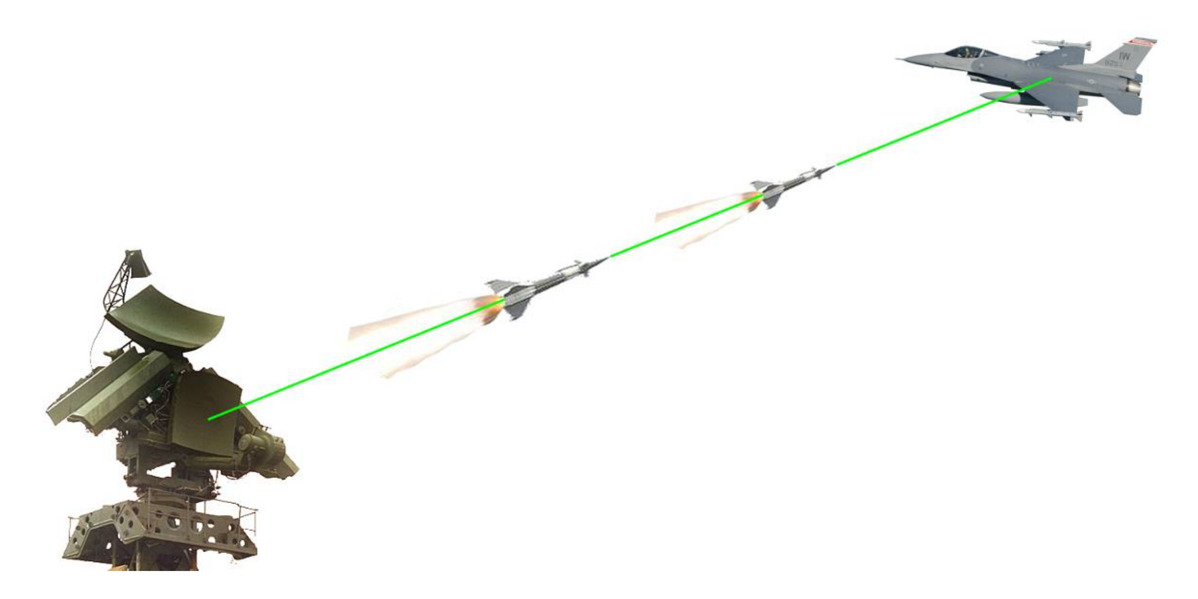
decimeter wavelength noise jamming, centimeter wavelength noise jamming



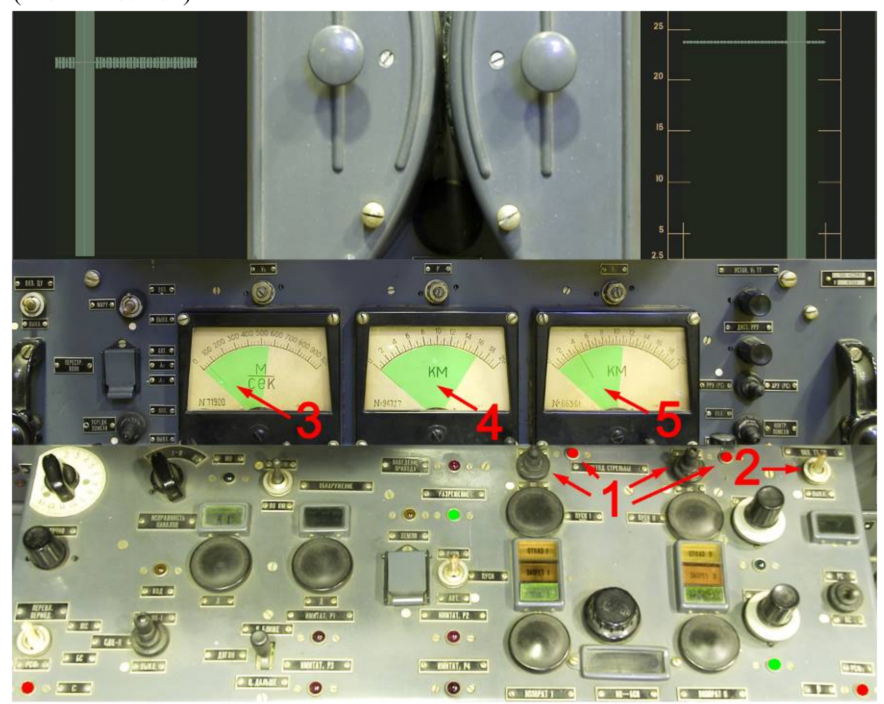
The noise jamming target is creating a vertical band in the indicators. It could be acquired in elevation and azimuth, but not in range.

Engaging jamming target with “three-point” method

Against noise jamming targets, the “three-point” guidance method is used. (SNR – missile – target, all three points are inline) The missile is flying towards the jamming target all the time. The radio proximity fuse is armed right after the launch.



(Z or Y - button)



1, Both missile channels guidance method **МЕТОД СТРЕЛЬБЫ** selector is switched to **TT** up -“three-point”.
The red indicators are illuminated.

2, The automatic launcher instrument switch is set to “three-point”- up.

Using “three-point” guidance method, the system is capable to engage target of the following parameters: V≤560m/s (3), P≤16,5km (4), H≤11km (5), shown by the green areas.

Anti Radiation Missile (ARM)

ARM's, deployed since the 1960s, guide themselves to the microwave energy emitted by radars. As these missiles are visible in the radar screens, like fast approaching targets, the best defense against them is to turn the radar off in time.

Texas Instruments AGM-45 Shrike

The first fielded ARM, had significant limitations.



Fielded: 1963
Speed: 1,5Mach
Maximum Range: 45km
Length: 3,14m
Diameter: 20,3cm
Weight: 176kg
Warhead weight: 53kg

General Dynamics AGM-78 Standard ARM

The second ARM the US fielded, developed from the RIM-66 ship borne SAM. Provided increased speed, range and tactical flexibility.



Fielded: 1968
Speed: 1,8Mach
Maximum Range: 120km
Length: 4,2m
Diameter: 38cm
Weight: 589kg
Warhead weight: 100kg

Raytheon AGM-88 HARM

The state of the art ARM, it replaced the former types.



Fielded: 1982
Speed: 2,1Mach
Maximum Range: 150km
Length: 4,2m
Diameter: 25cm
Weight: 363kg
Warhead weight: 65kg

Target Engagement with Emissions Control

As our missile has comparable speed to incoming ARM's, limiting our radio electronic exposure to the time period of missile guidance will dramatically increase the battle survivability of the system.

(X - button)



Tracking of targets visually could be done in passive mode, where the antenna receiver is open (3 - up), but the transmitter (1 - down) is turned off (2). Because the radar is not emitting it cannot be detected by electronic countermeasures and SIGINT receivers.

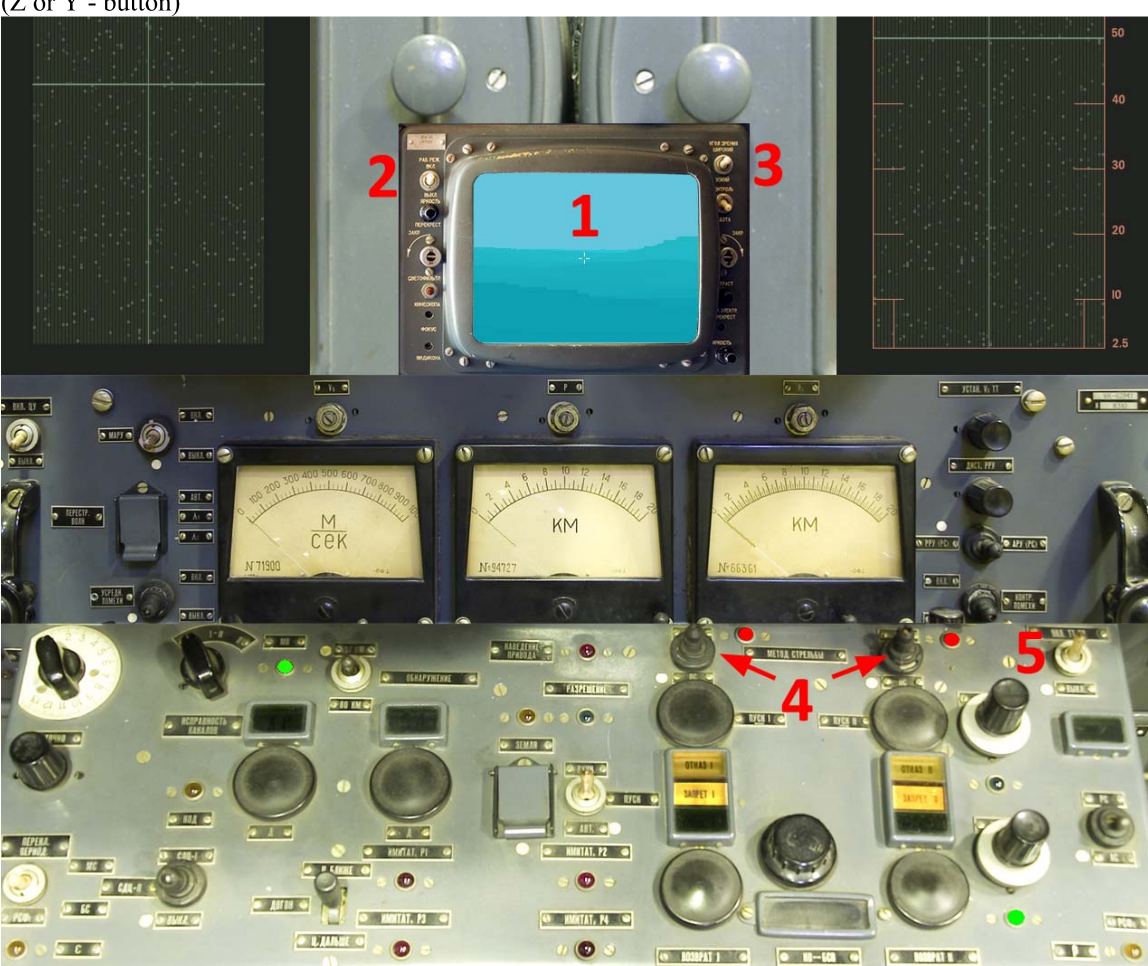


The black and white daylight only, 67kg 9Ш38А ТОВ (9Sh38A TOV) optical target tracking camera has a wide 5° (F=150mm) and a narrow objective 1.5° (F=500mm).



The small black and white TV screens in reality, are located on the manual angle trackers instrument panel, but for playability reasons, in the simulator, it is shown on the Fire Control Officers panel.

(Z or Y - button)

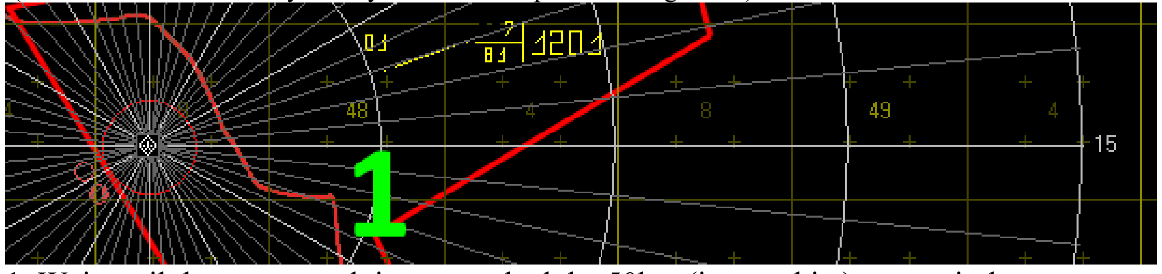


1. Push the “**D**” button to show the TV screen.
2. **РАБ.РЕЖ. ВКЛ/ВЫКЛ**, switch the camera on/off
3. **УГОЛ ЗРЕНИЯ ШИРОКИЙ/УЗКИЙ**, wide/narrow objective selector

4, Both missile channels guidance method **МЕТОД СТРЕЛЬБЫ** selector is switched to **ТТ** up -“three-point”. The red indicators are illuminated.

5, The automatic launcher instrument switch is set to “three-point”- up.

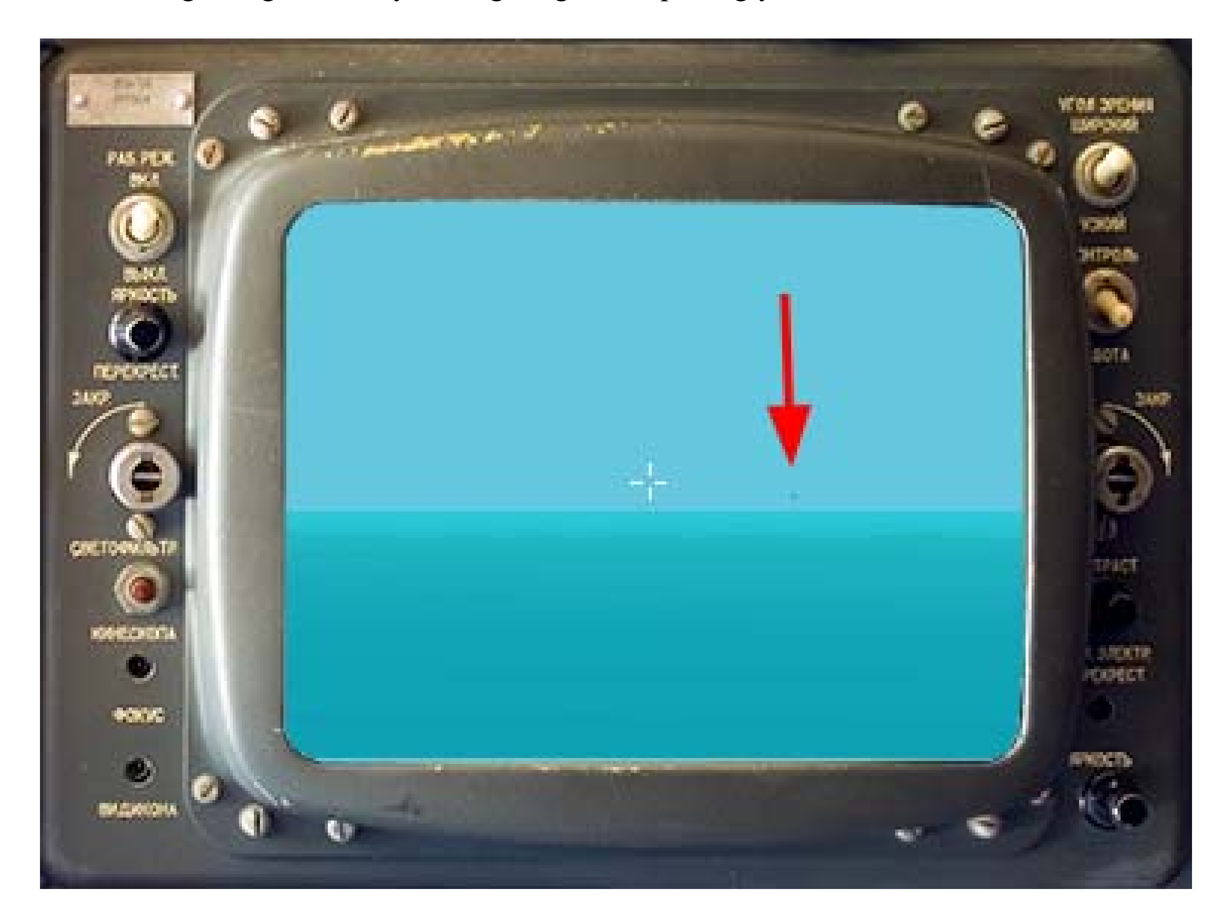
(Press the “W” button on your keyboard to call up the Plotting board)



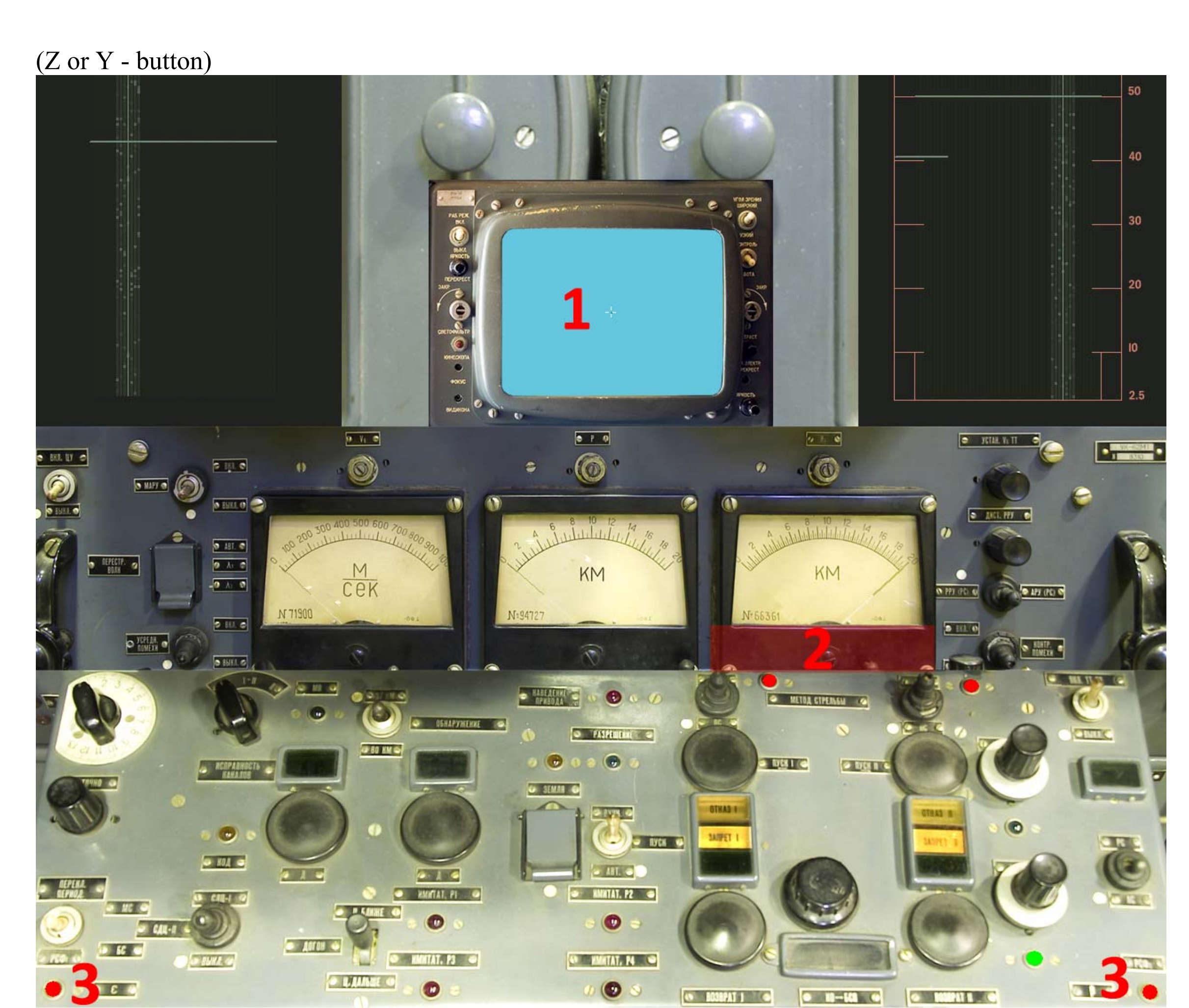
1. Wait until the target track is approached the 50km (inner white) range circle.

Rotate the SNR towards the target in azimuth using the P-15 as described in page 19, and scan slowly upwards, until the target is seen.

Discovering a target visually at long range is surprisingly difficult



(Z or Y - button)



Aim the PV towards the target (described in page 12). If its moved into the crass hair (1), we can click with the right mouse button in the red area (2), and the system* goes into automatic tracking in elevation and azimuth. The PCε, PCβ (target is in automatic tracking in elevation, azimuth) lamps are illuminated (3).

By reading off the target altitude from the plotting board (described in page 8), and distance from the P-15 display (described in page 9), the optimal firing time can be determined manually, by using the table below.

Target speed	Target altitude between	Maximum firing range
V<420m/s (Mach1.4)	20m – 50m	11km
	50m – 10km	17km
	10km – 11km	20km
V<300m/s (Mach1.0)	10km – 18km	20km

Limitations of the optical guidance:

- It can be used daylight only, in with good visibility
- maximum target speed is limited to 420m/s (Mach 1.4)

Low Observable, "Stealth" target

Low observable aircrafts were never advertised to be invisible to radar, they just have to fly much closer to be dicovered than their size would suggest.



The F-117A bomber, fielded in 1983 uses special shaping, and radar absorbent materials, to reduce its radar cross section (RCS).

While the cm and dm wavelength target acquisition radars detection range is severally degraded by these methods, the equipments using metric wavelength can detect it a bit easier.

During Operation Allied Force, the Serb Air Defense metric wavelength P-18 (Spoon Rest) radar was able to track the F-117A from the distance of ~30km.